HINTS

ON

MUSEUM EDUCATION

WRITTEN AND PUBLISHED

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An Appeal

to the good sense, broadmindedness, and
unprejudiced independent judgment
of the Authorities in charge
of
Museums
devoted entirely to the relics of antiquity
for
making over big images, walls, pillars, slabs, etc.
to
the principal cities of India
for
display in public places
and thus sparing room for
Exhibits appertaining to health and hygiene;
modern instruments, machines,
and scientific appliances;
principal products of the three kingdoms,
useful arts, handicrafts, manufactures, etc., etc.
so as to transform their existing museums
into proper

EDUCATIONAL MUSEUMS

May the Supreme Father vouchsafe light and strength
to all concerned
is the humble yet fervent prayer of the author!

DEDICATION

I dedicate this book to those, –

whose *reason* is free from prejudices;

whose *knowledge* is not enshrouded with wrong inclinations;

whose *conscience* is not dominated by the influence of others;

who entertain strong *fellow-feeling* for all persons;

who believe that they possess *very limited knowledge*;

and who are actuated by the spirit of *self-sacrifice.*

Author.

PREFACE

Museum Education is a somewhat novel idea, and the reader may pertinently ask what it means. Museum Education, as the name implies, is the diffusion of general knowledge by means of what are called Educational Museums, as distinguished from the existing public museums. The latter are, generally, store-houses of objects whose public utility and educative value are small. They have been founded with a different object. An Educational Museum properly so called, on the other hand, should contain exhibits covering all departments of life, with special emphasis on the modern arts and sciences, and important industries and discoveries, all arranged and classified in such a way that they can be examined at close quarters and actually handled under the supervision and guidance of a competent guide or instructor. While the existing public museums of India have, no doubt, great cultural value to students of antiquity and may be maintained where there is a superabundance of funds, the establishment of Educational Museums adapted to supply the requirements of students and the general public are the crying need of the moment. This book is intended to be an appeal for the establishment of Educational Museums at all the important centres of education.

2. The education in a large number of useful subjects by means of museum is such a vast affair that a regular

treatise on it would cover more than 5,000 pages. But as I am an old man of 79, I could not dare to undertake such a big work. So I remain satisfied with publishing only "Hintson Museum Education." Instead of publishing such a big and costly book, it is better to publish cheap pamphlets on different subjects, which will be helpful in studying the exhibits.

3. The first museum in India was started at Calcutta in 1814 and it has developed largely in the course of 124 years It is a matter of pride to its conductors that it can boast of a stock of 300,000 geological specimens, 48,000 rock-specimens, 27,000 fossils, 468 meteorites; and large collections in the zoological and ethnological sections. It claims to possess archaeological collections, far larger than any other museum in the country. It has a large stock of old pictures and various industrial manufactures. Though so rich in the collections appertaining to these branches of knowledge, the museum has unfortunately taken no active steps, as yet, towards providing exhibits suited to the requirements of students and the general public.

Its one ambition appears to be to collect as many exhibits as it can get hold of, representing a single subject. For instance, while it is already in possession of as many as 300,000 specimens of geology, its budget provides substantial funds every year for making further additions to the existing stock. It is spending Rs. 29,000 on relics of antiquity, to increase its already vast stock on the subject; and likewise something like Rs. 50,000 on adding to its zoological and ethnological sections.

4. There are, at present, four kinds of museums to be found in India:--(1) Local archaeological museums, founded by Government on the sites of excavations; (2) Museums attached to college laboratories for the study of practical subjects, such as, pathology, biology, geology, agriculture, etc.; (3) Archaeological museums started by Indian States or by private societies; (4) Museums of a mixed nature, holding old relics, as well as, exhibits on one or more of the following subjects:—zoology, geology, ethnology, industry, fine arts (as pictures), etc. I have no quarrel with museums of the first two kinds; but I have a serious complaint against those of the 3rd and 4th kinds, and that for the following reasons:--

(1) Their chief object is the display of their stocks and not imparting knowledge to the visitors.

(2) Consequently they do not seek the co-operation of educational institutions and consult them with regard to their requirements.

(3) They measure their utility by the number of their visitors; they take pride in their collections of relics of antiquity, animals, geological or ethnological specimens, etc.

(4) In making their collections they ignore the claims of subjects of vital importance, such as, Eugenics, Maternity, Childwelfare, Dietary, Temperance, Health and Hygiene, etc. Well-selected exhibits on these subjects are obviously of far greater educative value than the exhibits, meant for advanced students on geology, mineralogy, botany, zoology, ethnology, fine arts, archaeology, etc.

(5) It goes without saying that it is not the duty of museums to impart regular instruction to the visitors on the various subjects represented by the exhibits, as is done in schools and colleges. My humble suggestion is that they should make arrangements, also for display of as many articles under each subject as are necessary for imparting *general knowledge* of them to laymen and to school-students. If they can provide exhibits of advanced nature on these subjects for the benefit of technical students, they are welcome to do so. For a proper Educational Museum, the *General Principle* should be, that they should be so organised as to be in a position to impart *general knowledge* on all useful subjects to the visitors.

CONTENTS

	Pages
Importance of Educational Museums	I to XIV
Preliminary Remarks ..	1 to 56

Classification of Exhibits

I. Foods: —(1) Cereals, Pulses, Starchy Foods: (2) Vegetables, Fruits, Nuts, Roots, Bulbs, Greens: (3) Milk and its Products; (4) Animal Foods: (5) Invalid Foods: (6) Miscellaneous Foods: etc. 57

II. Ordinary Drugs:—(1) Spices; (2) Vegetable Drugs: (3) Mineral Drugs: (4) Animal Drugs: (5) Chemical Drugs: (6) Mixtures and Compound Medicines; (7) Intoxicants. .. 135

A. Medical Appliances. 141

B. Methods of Cure and Mental Cures.—1st. Systems of Curing Diseases (14 kinds), 2nd. Various Methods of Cure (21 kinds), 3rd. Mental Cures (13 kinds). 142

III. Dresses.—Toilets. 144

IV. Ornaments and Jewels 146

V. Household Utensils. 147

VI. Household and Office Furniture and Building Materials. 148

VII. Houses and Architecture:—Important Buildings and Structures of the World, such as, Temples, Churches, Tombs, Bridges, Manufactories, Bird's-eye Views. 148

VIII. Land, Water and Air Vehicles. .. 151

IX. Papers and Printings. 156

X. Writing, Drawing, Printing and Teaching Materials. 157

XI. Drawings, Paintings, Photographs, Lithographs and Printed Pictures. .. 158

XII. Stamps and Coins. 159

XIII. Sports, Amusements and Toys. .. 160

XIV. Musical Instruments and Plays. .. 161

XV. Geology.—Minerals, Metals, Earths, Stones, Fossils, etc.— 162

XVI. Minerals and Metals 167

XVII. Botany.—Trees, Plants, Leaves, Flowers, Timber, Roots, Barks, Fruits, Seeds, etc.—Vegetable Products. Some additional paragraphs on Botany and Zoology .. 169

XVIII. Chemistry:—Chemicals, Crystals, Acids, Alkalies, Salts, etc. 183

XIX. Mechanics & Machines:—Tools, Implements, Weapons.—Mechanical Movements.

Appliances and Machines relating to,—(a) Workshop, (b) Gardening, (c) Agriculture, (d) Dairy, (e) Spinning, (f) Weaving, (g) Navigation, (h) Railways, (i) Aeroplanes, (j) Motor Cars, (k) Tramways, (l) Steam Engines, (m) Grinding, (n) Hydraulic Press, (o) Electric Engines, (p) Cranes, (q) Clocks and Watches, etc. 186

XX. Arts and Manufactures:—

A. Textiles:—Cotton, Woollen, Silken, Jute, Flax, other Fabrics, as, Carpets, Durri, Mats, Velvets, *Galicha*, Oilcloths, Waterproofs, Waxcloths, Tarpaulins, etc.—Dyeing and Printing.

Raw Materials:—Cotton, Wool, Silk, Jute, Flax, Hemp, Agate, etc.

B. Hardwares:—Raw materials of pig iron, cast iron, wrought iron, steel, zinc, copper, tin, lead, aluminium, etc.

C. Metal-wares with workmanship on Gold, Silver, Copper, Iron, Brass, *Kansa*, Tin, Aluminium, etc.—Engraving, Enamelling, and Electroplating.

D. Pottery, Porcelain, Glasswares, Cement, Plaster: Works on Ivory, Stone, Wood, Horn, Bone, Leather, Mother-of-Pearl, Precious Stones, Conches, *Shola*, Coconuts: Lacquer-wares, Rubber-articles, Brush-works, Bone-works, Bamboo-works, etc.

E. Dyes, Paints, Varnishes, Polishes. .. 191

XXI. Physics:— Statics, Hydrostatics, Dynamics, Sound, Heat, Light, Magnetism. .. 192

XXII. Electricity. 212

XXIII. Some other Sciences:-(a) Geography and Physiography, (b) Astronomy, (c) Physiology and Pathology, (d) Engineering, (e) Sanitation, (f) Social Science, (g) Economics, (h) Ethnology, (i) Anthropology, (j) Antiquity and (k) Archaeology, etc. 239

XXIV. Some Mysterious Sciences:—(a) Physiognomy, (b) Astrology, (c) Palmistry, (d) Phrenology, (e) Mesmerism, (f) Hypnotism, (g) Readings from Handwritings. (h) Spiritualism, (i) Occultism, (j) Yoga, etc. 256

XXV. Some Modern Methods of Education:—(1) Kindergarten, (2) First Aid, (3) Scouting, (4) Social Service, (5) Puzzles and Curiosities, Optical Illusions, Magic, Comical Dresses, Cartoons, Caricatures, Punch, Decorations, etc. 261

XXVI. School Exhibits from (a) Primary, Secondary and High Schools, Technical Schools and Colleges: (b) Girls Schools and Colleges. 263

XXVII. Guide Books and Maps of Important Railways and Places. 263

XXVIII. Reports, Curricula and Rules of Indian and Foreign Schools, Colleges, Universities, Societies, Museums, and Exhibitions. 264

XXIX. Directories, Catalogues, Dictionaries and Books of Reference. .. 265

XXX. Pictures, Nativities, Horoscopes, Handwritings & Signatures of Famous Persons. 265

XXXI. Social, Postal and Commercial Forms.—Deeds and Documents. 265

XXXII. Useful & Interesting Information and Statistics. 266

XXXIII. Museum Library. 266

XXXIV. Children's Museums. .. 268

XXXV. Suggestions for Reformation. .. 270

IMPORTANCE OF EDUCATIONAL MUSEUMS

1. In this brochure opinions of some educated persons, professors, teachers and educationists, as well as reviews of some newspapers and journals in support of the museum scheme mooted in my book "*Educational Museums*" are presented to the discerning and the patriotic public for their thorough consideration of the subject and for taking any suitable action in the matter. My object of publishing the reviews of a book of 65 pages in 48 pages of another book of bigger size might obviously be misinterpreted or misjudged by the readers, and hence a word in making the object clear should perhaps not be out of place. The *Reviews* were not published to show the importance of the book, as is customary with authors or publishers who are impelled by mercenary motives, but rather to show the importance of the subject treated in the original book. Considering that I freely distributed 98 per cent. of the book, my object in publishing the '*Reviews*' can never be attributed to any desire on my part to push on the sale of the book and its Reviews. My object in publishing book after book on the same subject is to repeatedly draw attention, by appealing to the stock of reasoning of those who are inclined towards educational reform, as also to the great importance of Educational Museums.

2. The Mayors, several Councillors, and the Education Officer of the Calcutta Corporation have expressed their approval of the scheme; but none of them has taken any practical step

for giving effect to it. It is a wonder, that although the Corporation have been running 230 free primary schools in the city, having thousands of students on their rolls, and although there are several thousands of pupils in the other schools and colleges of Calcutta and its environments, yet neither the Municipality nor the Education Department and the University cared to start an Educational Museum at Calcutta, although I have been appealing to them for the last two years. The reason is not far to seek. They mostly entertain the wrong notion that the "Indian Museum" (of Calcutta) is supplying the want of an Educational Museum. Unfortunately it is difficult to dispel this wrong notion. I have given a concrete example of Calcutta; but conditions in this respect prevailing in other cities of India, where museums exist, are the same too. It is a regrettable matter that the Members of the Legislative Councils, who in a sense are representatives of the people, Directors of Public Instruction, Syndics and Senators of Universities, Principals of Colleges and Headmasters of Schools did not take any interest in the matter of Museum-education. Introduction of a novel system in education is naturally looked upon with suspicion and indifference. In my book I have drawn up a scheme which is at once simple, cheap, comprehensive, practical, educative and well-suited for Indian conditions. I freely distributed some 280 copies to the heads of the Education Department and educationists, soliciting them for the support of the scheme; but they have turned a deaf ear to my supplications. However, I never felt daunted or disappointed,—I still entertain the hope that

on some future date, distant though it be, my scheme will eventually take a practical form.

3. It is a very difficult task to move either the Government of India or Provincial Governments to take interest in the matter of Education through Museums. Most of the educated Indians are enchained by prejudicial and wrong ideas regarding the importance of such subjects as archaeology, numismatics and anthropology,—ideas which have taken such a deep root in their mind in the course of a century, that they are incapacitated from considering the higher claim of Educational Museums over the existing ones of archaeology, etc. The Government officials also hold the same sort of idea. The officers and staff of the Archaeological Department cannot but support the existence of their Department, for obvious reasons. Generally speaking, masses do not take any interest in things of antiquity; although, of course, they feel pleasure in seeing strange things. The Museum authorities are satisfied by merely showing to the Government that large number of persons visited their Museums,—the majority of whom are mere curiosity-mongers. The Government think that as they are spending large amounts of money every year over the existing Museums, and Archaeological, Zoological and Botanical Departments, they have done their best and their duty is finished there. Half-a-century ago this kind of satisfaction on the part of Government might have been thought reasonable. But in the present advanced age of new discoveries and inventions, the spread of knowledge of new arts and sciences and improved methods of Museum-education on

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a variety of subjects, together with new materials and appliances, our antiquated ideas should be replaced by reformed ones. To my mind, there are two methods for moving the stupendous machinery of Government. The first is that the Provincial Legislative Councils, the Legislative Assembly and the Council of State should pass resolutions for first reforming the existing Museums by transforming them into Educational Museums; and secondly by establishing Educational Museums separately. The success of the second method greatly depends on the Universities, Directors of Public Instruction, professors, teachers, staunch educationists, who should individually and collectively send representations to the Central and Provincial Governments, and the Central Advisory Board of Education.

4. The Education Officer of the London County Council, under which ten lakhs of students are being educated, in his letter, dated May 2, 1934 (see letter No. 17 of this book) writes,—"There also exist in many schools small Museums formed by the pupils themselves who contribute specimens of botanical, geological, historical or other interest." It is a matter of great regret that nowhere in India is there an educational Museum of a comprehensive character. Even the big, rich Indian States have not thought it necessary to establish Educational Museums for their school or college students and millions of subjects. These States can easily start such Museums and thereby practically demonstrate their utility to the Imperial and Provincial Governments of British India.

5. On pages 49 to 53 of my book *"Educa-*

tional Reformation in India" you will find a short sketch of a *Children's Museum* of New York city, U.S.A. It was opened in 1899 with 200 books as a nucleus. Now it is the largest institution of its kind. About 2 lakhs of pupils are being educated there every year. "Daily lectures are delivered at 4 p.m. on different subjects, illustrated by motion-pictures, lantern slides and objective materials."** "This kind of museum quietly has been duplicated more or less faithfully in the past few years in some 40 cities of the United States, and even in England and Japan." These facts should open the eyes of the conductors of "dumb" Indian Museums. India is so backward in the race of advanced nations that even most of the educated persons entertain the notion that, unless a museum collects articles of curiosity, it is no museum at all! Their old notions about museum might not undergo any change even in their life-time. They cannot think that the scope of modern museums has expanded and its present object is that of an utilitarian character. The desired change of outlook might take place in their future births. They have no idea of the educative value of a museum which I am describing. Public money is spent for the existing museums of India, but little educative purpose is really served by them.

6. I request the education officers of India to read the following few lines and calmly consider how Russia has taken up a more practically advanced course of educating her children. "Recently the Soviet educational authorities have taken steps to inject into the children of this country a love for machinery and modern

technique, with a view to create a nation of engineers and technicians, and of turning the country into a highly industrial country. * * The children are helped to build model railway lines upto 3 kilometres (nearly 2 miles) in length. They build the cars, locomotives, stations and all other equipment necessary for running a model children's railway line. The entire work is done by the children under the supervision of skilled engineers, and upon completion, is operated by the children themselves." (*Dayalbagh Herald*, March 17, 1936). Are the children of India worthless? Have they no capacity to learn these things? My emphatic reply is that they have the necessary capacity, but on account of the wrong methods of the educational authorities of India these children are generally weak in physique, while their intellectual faculties are misdirected in wrong grooves. If the needful educational facilities are given to them, these Indian children can vie with the children of other countries. They should be taught, (a) how to write a good hand by seeing specimens of good handwritings; (b) how to decorate by showing them sample decorations; (c) how to prepare nice scrapbooks; (d) how to collect, classify, and keep in order various specimens in the three kingdoms of Nature; (e) how to entertain themselves with puzzles and curiosities in language, arithmetic, geometry, etc., (f) how to collect important information and statistics, pictures and drawings on different subjects, such as famous persons, races of mankind, manners and customs, etc., as are enumerated in the book '*Educational Museums*'

(pages 52 to 54); (g) how to amuse themselves with scientific, mechanical and electrical toys, magic, mimicry, physical plays, dexterous feats, tests of intelligence, etc., etc. Such are some of the means of developing their mental faculties, wit and humour; of satisfying their hobbies, curiosities, mechanical and industrial propensities; and of teaching the art of keeping and arranging things tastefully, orderly and artistically. In this small preface I am able to mention only some of the means of education and recreation.

Museums and Exhibitions Compared

7. Let us now compare calmly the educative values and advantages of Exhibitions and Museums. The former are held for short periods—say a week, a month or 3 months—in temporary structures. Some of the exhibitors explain certain processes of the manufactures of their articles, but seldom disclose the secret processes. In India two or three International Exhibitions were held. I visited two of them one at Calcutta in 1883 and the other at Allahabad in 1910. Although lakhs of people visited them, in course of 3 months, still millions of persons could not find it convenient to undertake distant journeys for visiting those exhibitions. It was reported that Jules Jubert the organizer of the Calcutta Exhibition made a profit of one lakh of rupees,—gross income being 11 lakhs, and gross expenditure 10 lakhs. Leaving aside the illiterate, ignorant village people, who are nothing better than curiosity-mongers and sight-seers, even graduates and teachers of arts

courses have very little knowledge to understand the scientific, mechanical or electrical processes of various manufactures, because they seldom care to investigate into these matters. These big exhibitions are like fancy fairs, which provide sports, cinemas, theatres, magic, dancing, singing, concert, wrestling, boxing, gymnastics, lotteries, drinking, and feasting and a lot of amusements, in order to attract all sorts of people and to fetch money by the sale of tickets. The main object of education is thus frustrated. The result is not a matter of jubilation or congratulation, but it is a matter of sorrow and regret that after so much fuss and fury and spending thousands of rupees, no tangible benefit results.

8. As the conductors of some of the existing Museums of India try to prove the usefulness of the Museums by keeping records of the number of visitors;—similarly lovers and supporters of big Exhibitions are naturally prone to prove the importance of holding such Exhibitions by the number of visitors. Detach the sports and amusements, the number of visitors will be reduced to one-fourth or so. Such remarks as these might not be pleasing to the organisers, but one should not hesitate to disclose the actual facts. Presence of motley crowds is not the criterion of usefulness. The students who are trained in museum-education and whose power of observation and investigation has developed to a certain degree, can derive benefit by visiting big Museums or Exhibitions. Before teaching the students, competent teachers should first learn what to teach and how to teach by the regular study of books on object-lessons

and Museum-education. As a student of mediocre intellect cannot gain any knowledge by simply visiting a physical or chemical laboratory, so we cannot expect that village people will pick up useful knowledge by simply sight-seeing without explanation. This assertion can easily be tested by asking 100 ignorant people, after they have visited a Museum or an Exhibition for 5 or 6 hours, what they have seen. Even 1 or 2 per cent. of them cannot give any sensible reply.

9. I may mention here that annual or occasional fairs or *melas* for the sale of commodities of daily use, works of art, agricultural products and live-stock are being held in different parts of India from a very long time. They are not costly affairs like the big Exhibitions of Calcutta or Allahabad, their object being the ready large sales of articles;—amusements do not form prominent features in them. The present-day Swadeshi *melas* are of this nature. They are sometimes self-supporting; at other times causing some loss. These exhibitions give publicity to the Indian manufactures; and push on the sales. Holding of such exhibitions should be encouraged. Health, hygiene and maternity exhibitions with baby-shows, with explanatory lectures, should be annually held in every city of India. Whole railway trains, containing exhibits on health and hygiene and passing along principal lines and halting at important stations, is a nice method of imparting education to the villagers who are too poor to visit exhibitions or museums of big distant cities, but in such cases lecturers should travel with these trains, otherwise they will not prove of educative value to the people.

10. If the leaders of India calmly think over the matter, I hope that they will try to establish Educational Museums of general character, including agricultural, mechanical, industrial and commercial sections in substantial buildings, having a provision of guides, teachers and lecturers. Thousands of students and enquirers will then derive benefit from these museums for a number of years. Easy-going people and lovers of amusements and recreations, being carried away by their impulse, might support the idea of big and costly exhibitions. But unfortunately it is difficult to find even 5 per cent. amongst the educated classes, who would practically support the scheme of educational museums in India. If they have any reasonable grounds against the scheme, let them clearly express their objections with strong arguments. For the last 3 years I have been crying in the wilderness for the fruition of my museum scheme! I earnestly and importunately request the leaders of India to think over once, twice and thrice about newly proposed scheme of museum education. Although in the international exhibitions of the advanced countries of Europe and America, there are provisions for a number of amusements, still a large number of technical experts pick up new ideas from the newly invented mechanical, chemical and scientific exhibits. In India likewise our first duty is to educate a sufficient number of young men in technical arts and sciences, and thus make them fit for gathering new knowledge and ideas from the exhibits.

11. The Educational Museums and the Industrial Exhibitions are similar devices for imparting

education. But big temporary Exhibitions, held at the intervals of 20 or 25 years at different distant cities of different Provinces, can hardly teach students and research scholars who live during these long intervals of 25 years, which is the average life-time of the Indians. Whereas properly furnished and well-conducted Museums will be systematically utilized by all technical students for years continually without intervals. It is more economical and judicious to spend even double the amount for a well-equipped Museum in order to derive greater and more lasting benefit.

12. After studying the lives of some great inventors and discoverers, I have formed a conviction in my mind that, as we are in the dark as to those boys or girls who will become great inventors or discoverers, it should be the *duty* of Government and society to give as much facilities as possible to *all* boys and girls for acquiring technical knowledge according to their capacity and inclination. Educational Museum is itself an important facility. Neglect in the discharge of duty in this respect will be a social sin against such students who have potentiality to become great in industries. As a believer in re-incarnation, I would think it advisable to give the re-born astronomers, chemists and mechanics the advantages of big observatories, chemical laboratories and well-furnished workshops. But as we are ignorant of rebirths of famous souls, we should give facilities of proper education to *all* children as suggested above. If extraordinary intelligence is manifested in certain young prodigies, special facilities should be offered to them

for the unhampered unfoldment of such intelligence. Thus equipped they will disclose more secrets of natural laws by further discoveries and inventions.

13. Unless machines of various manufactories and the processes of their working are shown and explained to the technical students, it is only impossible to teach them any industry. As at present meagre grants are given to technical schools and colleges, each of them can teach only 4 or 5 branches by demonstration, and passed students with difficulty get admittance into some factories and manufactories for practical training for a certain period, say, 1, 2, or 3 years,—after which period they become qualified to enter into service. Majority of factories and manufactories do not allow even admittance to these passed students, so that their secret processes might not be out;—such is the state in foreign countries also. Keeping these circumstances in view which are unfavourable to the students, it behoves us that there should be a Central Industrial Museum in India in which valuable machines and appliances for teaching various technical arts and sciences should be stored up; and practical training to deserving students and organisers of industries be given. If this scheme be carried out, it will remove a great educational drawback of India. As in India individual technical schools and colleges cannot procure valuable machines, and even different Provinces are at present not ready to found an elaborate Museum containing valuable machines and to provide able teachers for explaining their workings, it would be a judicious step for all the Provinces to make a united

effort for establishing a big Industrial Museum at a central place of India. Then gradually, as technical education will spread over India, every Province should establish a similar Museum.

14. I begin this paragraph with a few lines quoted from "*Pictured Encyclopaedia*" published in 1935;—"The first British State grant was not voted until 1833, the sum being only £ 20,000. In 1891 provision was made for the free education of all between the ages of 5 and 14." * * "There are now over 20,700 public elementary schools in England and Wales, over 1,000 secondary schools, and over 3,000 technical institutions." In India, the population of which is 8 times that of Great Britain, there should be at least 3,000 technical institutions. But the fact is that there are only about 100 well-equipped technical schools and colleges in India. For the opening of cottage industries, education given in ordinary technical schools might suffice. But for the establishment of big industrial manufactories, a vast amount of money will be necessary for suitable machines and maintenance of technical experts. A Provincial Government is not expected to come forward with the required money. Therefore, I am submitting a proposal for a Central Industrial Museum to be maintained by the Central Government out of the funds to be contributed by all the Provincial Governments. The systematic education of the students in technical arts and industries is only possible by continued strenuous efforts for years, which can *never* be obtained in a few days by mere short visits to an Exhibition.

15. In conclusion let me make an earnest and ardent appeal to all Government officials who

are in charge of the departments of Education, Industries and Agriculture, to the Rulers of Indian States, to the authorities of Universities, Colleges and Schools and all those who have a strong desire to educate the people of India in the right direction, to calmly think over the above proposals and take active measures for carrying out the scheme. May, by the Grace of God, sympathy for the ignorant masses be generated in the mind of the educated people. Let the young men be well-trained for industrial pursuits. This is one of the means to educate the people and to improve the industry of India.

HINTS
ON
MUSEUM EDUCATION

Preliminary Remarks

(1)

Spread of Museum Knowledge

As Education through Museum is a new idea and as it has not been given a trial in schools and colleges of India, the advantages in introducing this new system on an extensive scale, which are likely to accrue to the cause of Indian education, can be realised fully when we consider them in relation to the existing system. Let us consider them briefly. Firstly, it would generate power of observation, spirit of enquiry and desire for investigation in the minds of students. If this desire of the student be finally transformed into

a zeal to know minutely the properties and utility of an object, its sources and processes of production, and its further particulars, then he gradually becomes a research scholar. In all stages of school or college education, Museum-education can be imparted according to the capacity of the students in their various stages of mental development. If students pay flying visits to exhibitions or museums, without first preparing their mind to be recipient of detailed knowledge of the exhibits, as opposed to outward knowledge of mere names, shapes or sizes, they cannot really gather any useful knowledge. Let me explain my point by three examples:—1st, an ordinary repairer of clocks and watches, knows their different parts, how they are fitted, how they work, their defects in working, their prices, whence they can be had, etc. 2nd,—But the manufacturers of watches and clocks possess more minute and accurate knowledge of their parts, of what materials they are made, what kinds of machines are required for making those parts, etc. 3rd,—A scientific scholar should know the mathematical precision and mechanism of the several parts of clocks, etc., how to adjust the pendulums which expand in summer and contract in winter, etc. If a teacher explains the ordinary mechanism and working of a clock to his pupils, the latter will hear such explanations with rapt attention and thereby will learn about several mechanical movements. One of the natural means of developing inquisitive faculty of students is to allow them to see and examine a thing and its parts (if any) minutely; to enquire about its uses and properties; to verify them by actually using it

(if possible); to know the processes of manufacture; and the materials of which it is composed, etc.

It is superfluous to state that experts on the subjects tabulated in my pamphlet 'Educational Museums' should write elementary books on different subjects of practical interest in such a manner as can be easily grasped by school students, and eventually higher courses; and the education departments and universities of different Provinces should publish them in English and vernaculars. This is the way of disseminating Museum-education to the students and the literate or intelligent public at large.

(2)

Useful Knowledge *versus* Ornamental Knowledge

Let me present before the patriotic leaders of India a firm conviction of myself, confirmed in the course of the last 60 years. It is that books on health, hygiene, and on effects of smoking and intoxicants (including the attendant losses and evils of intoxicants); and technical text-books written in an easy popular form, will undoubtedly prove highly useful and helpful to the students and public of India in the imparting of useful knowledge of common things of every-day experience, as well as of more advanced scientific, industrial and mechanical subjects. Everything considered, such books are decidedly far more beneficial to students than records of unnecessary events of historical and antiquarian nature. Colleges and universities should give preference to the teaching of useful subjects of practical utility.

Let the students who have tendencies for the ornamental or unimportant subjects, study them at home and pass examinations and secure degrees. The educational grants from the Government, scanty as they already are, should not be spent in imparting training in merely ornamental subjects. We should judiciously utilize the brain-power of the Indians in first studying useful subjects rather than tax their memory with facts, figures, ideas and events seldom brought in requisition in every-day worldly life. Some literary persons hold opposite views by advancing a reasoning that by the study of their favourite subjects the students acquire so-called necessary 'culture'. I admit that their reasoning is right to some extent; but I deny that purely literary subjects have any *special* claim in effecting the culture of the mind. One can become a man of culture and refinement, even without being a literary man, by living in company with cultured people. The meaning of the word *culture* according to Webster is "the act of training, disciplining or refining the moral or intellectual nature of man." Indian schools, colleges and universities pay very little attention to the development of the moral nature of students,—far less their religious nature. Their intellectual nature can be trained, disciplined and refined as well by close application of their mind to any subject relating to technical arts, sciences or manufactures. The niceties, subtleties and refinements are required in almost all technical subjects, such as, agriculture, sericulture, horticulture, pisciculture; manufacture of clocks, cycles, steam or oil engines, motor cars, electric appliances, etc. This is neither an arbitrary assertion on my part; nor it

is an imaginary theory, but it can be conclusively proved by actual facts that highly salaried experts are actually engaged in these arts and industries. The heads of the education department generally think of pouring into the brains of the Indians, whose average span of life is deplorably shorter than that of other nations, more of ornamental knowledge than of useful knowledge. I pray to them to feel pity towards the poor Indian students and earnestly request them not to try to make them like the astronomer of Æsop's Fables, who fell into a well when he walked along observing the stars, not caring even to see the danger lying ahead. My object in giving this example is to show that Indians should first be well-versed in the affairs of their daily life, before they may be tutored in ornamental subjects. We should equip the students in such a manner that they may first try to secure the bare necessities of life by the study of useful subjects, and then to cultivate their mind with less important or ornamental knowledge, if they have time, means and inclination to do so.

(3)

Well-directed Education

Allow me to place an educational problem before the educated public. How can persons, however learned they may be, form correct ideas of various works of art unless they actually see them; and try to know how they are made? It is necessary that the articles should be collected,

and oral or written explanation of the processes of how they are made should be given. Therefore the primary duty of the educational authorities will be to collect works of art and engage experts to explain the processes of their production by means of lectures or books. I think nobody can offer a better solution of the problem, because it is quite compatible with the fundamental principles of education. It is wonderful that in course of the last 75 years, since the introduction of public education in this country, the heads of schools, colleges and universities have not thought it their worthwhile to educate the students in practical affairs of life by means of education through Museums. Now is the time for mending the defect in this advanced century. We should not wait a century for the education of the masses till the Government will enhance the present education grant of 6 per cent. of their revenue to 12 per cent. or 18 per cent. If we have a true desire that the people of India should advance in the scale of nations, it would be the duty of thousands of such unemployed graduates and undergraduates to start propagandas for uplifting the masses by illustrative lectures on health and hygiene, common things and useful industries, who can afford to do so. Government and philanthropists should help them at least with sustenance allowance.

(4)

Memory not to be Taxed Improperly

I have purposely chosen the name of the second part of the book as "*Hints on Museum Education*",

because now I have no intention at all to write an elaborate treatise on the subject of Museum Education. A book dealing with such an important subject like this would cover thousands of pages to "illustrate every activity of the human race, both mental and physical",—in the words of Mr. Percy Brown, the Curator of the Victoria Memorial,—(see page 70 of my book *"Educational Museums")*,—which is embraced in my museum scheme. The teacher shall have to study a subject before he would be enabled to teach it to different classes of students. The students should be encouraged to put questions to the teachers; and therefore they should be first well-prepared to answer them.

In the year 1880 or so a text-book on ancient history of the world containing closely printed 500 or 600 pages was prescribed in the F. A. classes. I felt disgusted in committing to memory hundreds of useless dry facts and events relating to ancient history of the world, and wondered how the university text-book selection committee could be so cruel as to include in their syllabus of studies a book, the purpose of which seems hardly beyond taxing unnecessarily the memory of students by memorising dry facts. Our memory can act well within certain limits, beyond which it fags. That wonder of mine in course of 55 years grew more and more intense by observing that universities are pitilessly stuffing and overcrowding the brain of the young students with unnecessary facts and figures, caring very little whether or not their health, time and money suffered.

(5)

Instances of Useful Knowledge

It is a matter of great regret that school-boys, most of the students of colleges and universities, and even a number of graduates and teachers have very little knowledge about:—

(1) What to eat, how to eat, and when to eat? What are healthy foods? What foods are injurious to health?

(2) What are the sanitary laws regarding the proper uses, efficient working and preservation of the five sense-organs; digestive and eliminative functions; respiratory, muscular and circulatory systems; sex-hygiene; evils and losses of smoking and intoxication, etc. (Losses of the Indian people for using these injurious things are from 50 to 75 crores of Rupees every year.)

(3) Properties of the common edible grains, fruits, and vegetables of India and various animal foods; uses of water in health and disease; proper uses of milk and its products, etc.

(4) Personal, household and public sanitation; means of checking contagious diseases; climatic effects; principles of first aid; common medical appliances, etc.

(5) Effects of common indigenous herbs and drugs in disease. A great number of allopathic doctors seldom know their effects, and do not care to investigate into the properties of cheap common herbal drugs of India and they generally prescribe foreign medicines and foods; and the people of India have to spend

about 4 or 5 crores of rupees every year for these medicines and foods.

N.B.—The education departments and universities should publish popular graded books on these subjects for the students, and appoint medical teachers for such education after collection of health charts, food-stuffs, common drugs, medical appliances, physiological charts, etc. in a museum. I think it is superfluous to note here that medical teachers should be appointed by schools, colleges, education departments or universities individually or jointly for teaching the five groups of above subjects numbered (1) to (5) in a popular way.

Great ignorance prevails among the students and teachers of India regarding the following subjects :—

(6) Knowledge of useful ordinary mineral, vegetable and animal products of India ; places where they can be had in plenty; and their uses in various arts, manufactures and as food-stuffs.

(7) Knowledge of chemical and mechanical processes for the manufacture of various useful articles on commercial and business lines.

(8) Information and statistics of principal Indian arts and manufactures.

(9) Knowledge of common tools and implements; common machines used in agriculture, dairy, mining, printing, oil-presses, etc. and their parts.

(10) Knowledge of the commercial products of India and their uses, particulars and statistics. English and vernacular books should be published for imparting general knowledge of some important commercial products of India, carefully

selected from the very useful book '*The Commercial Products of India*' by Sir George Watt, published in 1908 and such other books since published.

I have given only very few instances of the wide-spread ignorance on matters of general interest. Graded books on such and allied subjects should be published and introduced as text-books and teachers should be engaged to explain them by illustrations and exhibits. This kind of practical education is needed in India,—an education which, while aiming at raising and improving the general standard of knowledge, may produce wide-spread awakening among students in particular and the people in general.

(6)

Study of Arts and Sciences and Exhibits of the Three Kingdoms

I simply wonder why the students of India are not given ample opportunities for seeing pictures or models of, and reading about, the modern wonderful works of arts and sciences, which are the results of the inventions and discoveries of the last and present centuries. For example,

Wonders of Physical Science, Electricity, Railways, Steamers, Aircraft, Motors, Gramophones, Bridges, Sky-scrapers, Cinemas and Talkies, Telegraphs, Telephones, Microphones, Broadcasting apparatus, etc., with their descriptions and principles of working.

It is a pity that they are not given facilities to learn about useful, curious and beautiful things

in the mineral kingdom, for example, jewels, radium, products and by-products of coal, earth, petroleum, etc.; models of Indian fruits and vegetables, edible grains; samples of seeds, nuts, woods, resins, etc.; pictures of principal trees, flowers, leaves and other vegetable products, such as cotton, fibres, roots, oils, etc.; pictures and descriptions of wonderful birds, beasts, insects, fishes, deep-sea animals, extinct animals, their habits, instinct of sagacity and self-preservation, methods of concealing themselves from the enemies, of their working in co-operation, of building their ingenious habitations, of preserving their species, etc.; customs and habits, sizes, features, physiognomy, intelligence, foods, living, etc., of the peoples of different countries or even of different parts of India, etc.

In India the teachers and the taught seldom take interest in studying articles of Indian workmanship and the processes of making them, broadly classified under the following principal heads, namely, metal wares, stone wares, glass and earthen wares, wood work; ivory, horn, shell and leather wares; lac and lacquer wares; textiles and woven patterns including dyeing, printing, etc.; embroidery, braiding, lace, etc.; needle-work, carpets, rugs; baskets, etc.; sculptures, paintings, architecture, etc. In order to be brief, I have left out here about 100 sub-classes of Indian Arts.

Indian travellers go to several places of India to see the ancient or modern famous buildings, *Mandirs* and *Masjids* and other structures; and rich people spend lots of money and go to different countries to see beautiful buildings, architectures, churches, tombs, monuments, cenotaphs, even

ruins of ancient cities and buildings, etc. Heads of museums, schools, colleges and universities do not think it their duty to educate the students and the people by showing them even the photographs or photo-prints of the above interesting things by spending the paltry sum of Rs. 100 to Rs. 1000 only. Photography was invented a century ago ; and photo-prints were invented in the 20th century ;—even very costly paintings cannot vie in exactness, faithfulness and cheapness with photographs and photo-prints. Thousands or rather millions, of such interesting pictures with short descriptions are selling very cheap in pictorial books and cards. Poor students and people of India can ill afford even to buy them ; but the high schools, colleges and museums can easily procure them for the students and the public. Who is going to approach them and knock at their doors with this simple request or appeal ? The feeble voice of this old, unauthoritative man won't reach their ears. If my appeal is even read by them, they might throw it in the waste-paper basket. Then, where is the remedy ? Utter hopelessness!

(7)

General Knowledge of Technical Subjects

There are some schools, colleges or classes of high standard for imparting education to the undergraduates and graduates of India on the following subjects :—(1) Geology, (2) Mineralogy, (3) Botany, (4) Zoology, (5) Chemistry, (6) Physics, (7) Civil Engineering, (8) Mechanical Engineering, (9) Electrical Engineering, (10) Agriculture,

(11) Medicine, (12) Accountancy, (13) Commerce, (14) Experimental Psychology, (15) Anthropology, (16) Music, etc. But there should be a good number of schools or classes for imparting general knowledge of practical nature to thousands of students, who have no opportunities to get admittance to higher schools teaching these subjects. Some provision should be made for the general students of schools and colleges, first to arouse their interest and inquisitiveness by means of showing nicely illustrated English books (if illustrations are possible) on these subjects accompanied by explanations, notes or lectures; or by taking them to museums containing exhibits in original, pictures, miniatures or models; and secondly, by opening popular classes for educating students or proper persons with experimental lectures. Let me clearly express my ideas regarding popular education on these subjects. Take the example of *Biology*. In biological classes the students are taught how the plant and animal life germinates and gradually develops by showing enlarged models of different stages of development in vegetable and animal life ; and by experimentation with the aid of microscopes. The students also learn the classification of vegetable and animal kingdoms by seeing the originals or pictures of different classes of plants and animals. This kind of scientific knowledge is utilised by those students who join medical colleges. Other students only gain knowledge in Biology but can make no use of it in after life.

Let me now briefly state what I consider *popular* education in Botany and Zoology, what portions should be retained and what portions to

be eschewed. Such general education may be quite sufficient and useful for practical, industrial, agricultural, social and commercial purposes. All the world over, I think, a very small percentage of people have acquired highly scientific knowledge of these subjects. Yet the majority of workmen in highly civilized countries also are only practically trained in these subjects; and by the application of physical energies and mental power they have made their nations industrially great. Let me give a concrete example. The almost illiterate mistries of our Iron Foundry used to draw the parts of a stationary steam engine and to mould, cast and fit them, and thus constructed some 16 steam engines of 12 H. P. and 16 H. P. for collieries—which have worked satisfactorily for years. They received no training in any school or from any engineer but they learned the art by seeing and repairing parts of steam engines. It is the bounden duty of the education department to make arrangements for showing machines and their parts to all students. They should also be shown exhibits on useful technical subjects and explanatory lectures should be delivered to them. School and college students should study elementary books on the subjects. They should be given all opportunities to visit workshops, laboratories and museums, and encouraged to ask questions on the subjects mentioned above. A number of Indian students are studying in England, Germany, U. S. A., Japan, Italy, etc. in technical schools and colleges. They can describe the *modus operandi* adopted by these advanced countries in educating their students and people. Also books

published by those countries on education will give an idea of their system of education.

One of the great obstacles in carrying out the plan referred to above is want of time of the Indian students in acquiring general knowledge. The big text-books of elaborate histories of England and India of about 500 pages each for Matric and F. A. classes, unnecessary detailed records of the reigns extending 2000 years except the Victorian era (which is closely connected with the progress and reforms of the 19th century as well as the administration of India) should not be stuffed into the memories of the young students. Short histories of India and England of 100 to 150 pages each containing the principal events are sufficient. In the history of India, more importance should be given to the present state, statistics and economic condition of the people, than to old things which have no bearing with the present. I think that 75 per cent. of graduates and under-graduates forget 75 per cent. of the particulars of unimportant events, battles, geneological tables of kings, lives of kings, etc., five years after leaving school. It is the duty of the historians to record as many facts as possible, but it is not necessary that the memory of the Indian students be mercilessly crammed with dry facts without calculating any benefit for so doing. These two histories should be published by the Education Department and the University Board after selecting with great scrutiny and reasoning what portions should be retained and what portions to be eschewed. Decisive battles, great reforms, inhuman persecutions, great discoveries

and inventions, short anecdotes of the famous kings, should be retained. When necessary, good or bad results of these events or actions should also be inferred and noted down in the text-books. But for such students who have a tendency to study big histories as an optional subject, existing big histories should be prescribed. No opportunity should be denied to the lovers of history; but, at the same time, no compulsion should be made towards the general students to memorize 1000 pages of history. If in this manner about 700 or 800 pages of unimportant matter be eliminated from the histories, the students will get much relief, and will find time to gather interesting and useful general knowledge of important sciences, arts, and technical subjects from museums, elementary books and explanatory lectures. Fresh seeds of edible fruit-bearing trees planted in the fertile soil are far better than the dried branches or twigs of hundreds of years old.

The study of elaborate histories should not be *sine qua non* for the education of young Indian students. A century ago the study of history was little cared for in England. All progressive nations have not aped the civilization of their ancestors. Without reading history a man can be a great scientist, discoverer, philanthropist and what not. In pages nos. 8, 9, 10 and 11 of my publication *Educational Reformation in India* this matter is considered at length. I think that it is not proper to engrave into the impressible brain of young school boys some 10,000 heterogeneous events of the past contained in 1000 pages of history, which are of no earthly

use in worldy life or affairs. Let them study and remember the rules of health and hygiene as published in my little books (advertised at the end of this book) or any other popular books on the subject, because they are more important than many unimportant historical facts.

Botany

Botany is the Science which treats of the structure of plants, the functions of their parts, their places of growth, their classification, and the terms which are employed in their description and denomination.

Botany is divided into various departments, as *Structural Botany*, which investigates the structure and organic composition of plants; *Physiological Botany*, the study of their functions and life; and *Systematic Botany*, which has to do with their classification, description and nomenclature, etc.

In order to teach the practical side of Botany, commonly used woods should be collected :—

Teak	Deodar	Mahogany	Boxwood
Sál	Mango	White Sandal	Catechu
Sisum	Semur	Red Sandal	Walnut
Soondry	Cocoanut-palm	Camphor	Tamarind
Jack	Babul	Rubber	Ash
Neem	Járul	Redwood	Beech
Pine	Oak	Ebony	Ply-wood
Cane	Sola	Wood for	Birchwood
Bamboo	Pencil-wood	match boxes	Baelwood
Sirish	Palmyra-palm	or sticks	Tun
Dhák	*Chir* or *Dhup*	Asok	Kael
Blue pine	*Garjan*	Iron wood	Plum

Teachers should explain various uses of wood in building, tools, furniture, presses, printing, tanning, dyes, essential oils, engravings, pencils, matches, paper, packing, etc.

There should be a collection of pictures of important trees, especially edible fruit-trees, shrubs, creepers, pot-herbs, roots, bulbs, tubers, mushrooms, etc. ; medicinal herbs, seeds, fruits, roots, leaves, stems, barks, etc. ; intoxicating and poisonous plants, fruits, seeds, leaves, etc.; curious plants, such as, insectivorous plants, bread-fruits, sago-tree, plant which gives drinking water, leaves which neutralize stings of scorpions and wasps ; leaves which sting ; fibrous plants yielding jute, flax, hemp, agave, rhea ; candle-tree, *shola*-stem, cork-wood, cotton-yielding plants (such as, *ak* or *akanda*, bearing silk-cotton), *kapas*, *semur* ; distinctive features of edible and poisonous fungi ; plants for paper-making, yielding rubber, producing lac, mulberry (for feeding silk-worms), making match-sticks and match-boxes, producing resins and turpentine ; trees of *tejpatra*, *daruchini*, laquarice (*jasthimadhu*), *sati* food, etc., etc.

Books should be published containing the general properties and uses of the above ; when, where and how to grow them ; how to make useful products out of them ; their chemical and industrial uses ; uses for arts, furniture, building purposes, making tools and implements, dyes and tans, etc. The students should be directed to collect and arrange seeds, fruits, fibres, roots, etc. Nicely stitching or pasting the leaves of flowers and ferns in blank books, noting their names, etc. is one of the means for the cultivation of aesthetic

taste, and for facilitating recognition and memorization.

Zoology

Teachers should collect zoological exhibits and explain the usefulness of certain animals and their animal-products to mankind. The zoologists can do a great deal of good to the public if they can properly educate the students and the people by lectures and publication of popular books on the following matters :—

(a) Uses and abuses of animal diet; flesh of what animals, such as, quadrupeds, birds, fishes, etc., might be eaten with impunity provided they are not suffering from any disease ; what parts should be eschewed, what kind of animal oils, fats, eggs, secretions, etc., are good or bad for our body ; poisonous or non-poisonous snakes, reptiles, scorpions, centipedes, spiders, lizards, rats, cats, mosquitoes, flies, fleas, bugs, dirty poisonous insects, rabid dogs, etc., whose bites are poisonous. What are the common measures for the cure of the effects of painful or poisonous bites, scratching or licking by animals or insects. In consultation with bacteriologists and doctors, people should be warned against the germs, which produce diseases, such as, malaria, cholera, typhoid, tuberculosis, scabies, itches, hookworm, etc. Animals, birds, fishes, insects, etc. which act as scavengers, and which protect crops from some insects, or which destroy crops ; or white-ants, etc. which destroy doors, furniture, clothing, etc. and how to stop their ravages.

Students should be encouraged to make collections of insects, butterflies, scorpions, snakes,

birds, etc.; products of the sea; pictures of beautiful or curious animals; etc.

People should be entertained with oral or published stories of the doings of faithful dogs and horses; about the instinctive faculties of detective dogs, clever rats, ingenious monkeys, fighting fishes, number-calculating elephants, weaving birds, bees, ants, etc.; cunning foxes, ingeniously-built nests of birds, bee-hives, wasp-hives, habitations of some animals; designs for catching, taming and utilizing tigers, lions, bears, elephants, zebras, etc., for circuses; about deep-sea animals, curious extinct animals, pouched beavers, messenger pigeons, rattle snakes, and big pythons, large whales, gorillas and chimpanzies of enormous strength; mimicry and freaks of nature in some creatures; spider-nets, silk-cocoons, etc., etc. They should be shown the economic products from animals, such as horns, hoofs, hairs, skin, hide, leather, tusks, nails, eggs, oil, fat, bones, etc., and explained their various uses and manufactures. Narrations about the gratitude, vindictiveness, wrath, memory, faithfulness, fellow-feeling between animals of different kinds living under the same roof, should be recited;—these narrations of facts are more educative than fabricated stories of old grandmothers.

From the above data and statements we can easily draw a conclusion that the present system of teaching the scientific side of biology is far less important and useful than the practical side explained above. I have compared the scientific side of biology with its practical side and leave it to the judgment of the educationists to adopt the practical line of education. Only a few selected

students should be encouraged to learn the scientific portion of Biology if they are so inclined.

It is true that artisans and manufacturers of India know the uses of some of the vegetable and animal products, but by means of further information and knowledge derived from hundreds of discoveries and processes they will improve their arts and manufactures. If educated students and intelligent workmen join their heads and hands, and if experts in foreign manufactures will show better and cheaper methods for producing useful articles, the people of India will march a step forward by improving their old processes. In order to compete with foreign cheap manufactures, we should try to introduce machines as far as possible and to replace hand-labour aiming at mass-production. In this manner great ignorance and deep-rooted prejudices of workmen will gradually vanish, and new light would brighten the heads of the students and workmen.

Now allow me to put one question to the heads of education department, whether they are ready to suggest a better plan for general education of an utilitarian character for the students and the artisans. If their plans are more advanced and beneficial, they should be adopted, and not mine. They in their turn can ask me what suggestions I have to offer for utilizing the spare time of the students profitably, if they are saved from committing to memory ten thousands of historical facts. In reply, I would suggest that they can be entertained and at the same time educated with true coloured pictures of 100 curious animals, 100 scientific recreations, 100 select pictures, 100 works of arts, 100 kinds of plays and pastimes, 100 indigenous

medicinal plants, or curious plants, interesting or nutritious fruits, beautiful flowers, strange leaves, etc., 100 puzzles and curiosities, 100 natural phenomena, 100 famous buildings of India or the world, 100 pictures of celebrated men (with hand-writings of some of them), 100 school exhibits (Indian or foreign), 100 kinds of food-stuffs, 100 varieties of decorations, 100 wonderful dresses and customs, etc., etc. The number 100 is put down by guess; it can be doubled or trebled.

Out of the 16 subjects for study mentioned at the beginning, I have shown how practical education can be imparted on Botany and Zoology. Some hints on the results of Experimental Psychology are given below. Similarly, the remaining 13 subjects can be taught either practically to a large number of students, or theoretically or scientifically to a few intelligent students, so that they might be experts or research scholars for guiding the teachers of the practical side in special cases. I will deal with the remaining 13 subjects, when they will come up in their turn in the *Classification of Exhibits* (see pages 25 to 28, of my book *Educational Museums*).

(8)

Mental Hygiene and Child Psychology

The Calcutta University College of Science has published a small pamphlet of 16 pages, named "Mental Hygiene and Child Psychology". In order to give an idea of the results of researches on the subject, I am quoting below a few sentences from it:—

"Very few people are aware of the fact that the mind has its disorders like those of the

body. The sufferings of mental disease often outrival the most intense form of physical pain such as that of cancer. Insanity as a form of mental illness is wellknown; but as malaria is not the only type of fever so insanity is not the only type of mental disease."

"Common Examples of Mental Illness;—(a) Mr. A is a responsible Government officer who takes an abnormally long time over his dressing table. (b) Mrs. B finds herself compelled to count up to fifty-one before she can attempt even the simplest act. (c) Mr. C is obsessed with a funny idea which comes into his mind repeatedly and defies all his attempts to forget it. (d) Mr. D, although he lives on the second floor of a Calcutta house in Clive Street, is in constant fear of snakes. (e) Extreme jealousy, shyness, punctiliousness are all manifestations of mental abnormality."

(1) "Mental disease is curable."

(2) "Mental disease begins in childhood."

(3) "Heredity and Environment.—Every human being like every other animal is a product of heredity and environment. A man is born with certain special aptitudes, that is, with certain special potentialities either for good or evil. These hereditary tendencies remain latent until they find a suitable environment for their development."

(4) "Room for Improvement.—The child, if it is brought up under favourable conditions, will grow up to be a normal man. If the conditions are unfavourable, the child may turn out to be a useless and even a dangerous member of the society. In every child there are potentialities for good or evil. Hence the great influence of proper nurture."

(5) "The Unconscious Mind.—Even in the most cultured person wicked anti-social tendencies and disgusting and shameful animal propensities exist in the unconscious region of the mind."

(6) "The Struggle.—The conscious mind however has to fight its unknown enemy at a disadvantage; it seldom knows that it is fighting at all.......In curing bad habits, nervousness, obstinacy, over-sensitiveness, neurotic manifestations and similar defects, psycho-analysis is found to be very useful as all these defects owe their origin to the unconscious factors of the mind."

(7) "Childhood Factors.—Most of our mental ill-health starts in the early childhood days, in fact before the fifth year of life.......If we could bring up every child in a normal way free from mental impediments the number of adult neurotics would become surprisingly low. Preventive measures applied to children are likely to be more fruitful in the domain of mental disease than in the case of physical troubles."

(8) "Sex.—It is popularly believed that sex cravings and sex knowledge come with puberty. The young child is supposed to be absolutely innocent of sex matters. The facts however are quite different. Sexual instinct is not a thing that comes suddenly into the life of the individual. The instinct is present from the moment of birth and grows continuously till at puberty it attains its normal development. There is no sudden irruption of sex in the individual. It is true the manifestations of child sexuality are somewhat different from those of the adult. Many psychologists believe that thumb-sucking so common in children is a modified sex expression. There

are several parts of the child's body such as the lips, the nates, the excretory openings and the genitalia which have a peculiar sensitiveness. Undue stimulation of any of these regions of the body may lead to the development of a feeling in the child akin to the adult sexual feeling. It must not be supposed that gross sexual manifestations are altogether absent in the child."

(9) "Neurotic (or Nervous) Disorders.—A large number of nervous disorders owe their origin to an arrest of proper development of childhood sexuality. Childhood sexuality thus holds an important key to the future mental development of the individual."

(10) "Precautions.—The mouth and the excretory openings in the child are specially sensitive parts, and regular feeding and evacuations prevent any undue accumulation of tension in these regions. In the child, sucking is accompanied by a pleasurable sensation and if food is not given at regular intervals the child tries to soothe itself by thumb-sucking till it comes to acquire this habit for its own sake. This habit is not only physically injurious but it also affects the child mentally. ...From its early age the child should be taught to remain alone and in the dark for some time daily. Passionate fondling and intense caressings should be avoided....Even sexual questions should be answered in a way suited to the intelligence of the child; one need not explain more than the child itself wants to know."

(11) "Education.—The love bond of the child is one of the most important factors which control his conscious activities and determine his future

interest and development. To educate a child properly an atmosphere of love is the most essential condition. The child imitates the person whom it loves and the interest of the child is moulded on the ideal of the loved person."

(12) "Mental Examination.—It is supposed that if you keep the body fit the mind also remains fit. This is an error which cannot be too strongly condemned. The physically healthy person may be a mental invalid and an utterly useless member of the society. The mind in many cases requires a separate treatment."

"If you find one or more of the following symptoms in any person, you may suspect mental disease:

Sleeplessness.
Constant absent-mindedness.
Loss of normal modesty.
Saying or doing the same thing over and over again.
Counting mania. (Counting up to a certain number before attempting to do anything.)
Washing mania.
Excessive doubt or shyness.
Talking too much.
Anxiety over everything.
To be apprehensive of serious illness or danger on the slightest account.
Excessive and constant fear of death.
To refuse to speak or eat.
To sit still in one place and not move.
Hesitation in doing the simplest acts.
To laugh or cry at the slightest cause.

Perfect mental health is rare."

In that pamphlet acts or behaviour of children at different ages, thus, 6 to 10 months, 10 to 18 months, 18 months to 2 years, 2 to 3 years, 3 to 4 years, 4 to 5 years, 5 to 6 years are given.

I am giving lists of acts or behaviour of children only of 6 to 10 months, and 5 to 6 years.

"A normal child 6 months to 10 months old can do the following:—

1. Can turn and lie on its stomach.
2. Can pop up its head and raise its breast when lying on its stomach.
3. Can keep its head straight when made to sit.
4. Can seize things with its hands.
5. Can seize things and put them in its mouth.
6. Can play with things in its hands and will cry when the things are taken away.
7. Can seize two things at a time one with each hand.
8. Can utter sounds like *Ma, Ma, Pa, Pa, Da, Da.*
9. Can laugh.
10. Can recognize its mother and express joy at the sight of her.
11. Can smile when it sees a smiling face and cry when threatened.

A Child 5 to 6 years old

1. Can copy triangles and squares like these △ □.
2. Can arrange 7 or 8 boxes after a given pattern.
3. Does not prattle but pronounces every word clearly and distinctly.
4. Can answer questions like these:
   Why are the leaves of the tree moving?
   Why is the mother beating the child?
5. Can keep his personal belongings arranged.

6. Can repeat 4 or 5 digits like 5-7-3-1-4 after hearing them once only.
7. Can distinguish between the right hand and the left.
8. Can say whether it is now morning or noon.
9. Can say whether its mother or its father is the older of the two."

Mental Disease Takes Root Before the Fifth Year of Life
Protect Your Children From Mischief

What not to do ?

"Never feed a child by force.

Do not force a child to do anything in anger, vexation, or haste.

Do not allow a child to remain slovenly.

Do not frighten a child into sleep or put it to sleep by telling it a story or by patting or rocking it.

To keep your child quiet do not frighten it with stories of ghosts, bogeys, animals, etc.

Do not allow a child to sleep on the same bed with its parents from about the age of one year and a half upwards.

Never lie to a child.

Do not rebuke a child for asking questions nor stop it even when the questions are about matters of birth. Give it true answers up to the standard of its intelligence.

Do not dishearten a child when it wants to do something beyond its powers.

Do not taunt a child or laugh at it when it makes mistakes.

Do not disturb your child with caresses when it is at play.

Do not excessively caress your child.

Do not give any toy which the child cannot manage.

Do not pamper the child.

Do not punish a child when you can correct it with kind words or tender behaviour.

It is never necessary to punish a child if it is properly brought up."

Do not allow 2 or 3 children sleep under a cover. (J. C. B.)

Order your servants not to excite the genitals of children. (J. C. B.)

"What to do ?

See that good and regular habits are formed by the child from birth. A child can be taught habits of cleanliness from the actual moment of birth.

Get a child accustomed to darkness from infancy.

Teach a child self-help.

Allow your child to play with other children; —(but not in darkness or secrecy.—J. C. B.)

Both parents, the father and the mother, must show equal love to the child."

N.B.—Please note that the above instances of mental aberrations and their remedies are only a few out of many not yet recorded or discovered.

Application of Psychology in Museum Education

Generally intellectual faculty develops in two ways;—(a) Remembrance of facts, rules and data, (b) Act of reasoning over those facts, etc. By the first process the memory of the students is exercised and by the second process their

reasoning faculty is sharpened. The main defect in the present system of education is that the memory of the young students is unnecessarily over-taxed in various ways,—especially by pouring into their brain several thousands of historical events of very little importance.

(a) Although it is true that bodily culture alone cannot help mental culture, as will appear from the great strength of savages and illiterate athletes of India, still it is equally true that weak or diseased body is a great obstacle to the healthy play of the mind. Therefore all students should study the rules of health and hygíene, and improve their body by following them. Museum should provide physical and medical appliances, books and charts on these subjects, and also books and pictures on the evils of intoxicants, lust and immorality, to improve the body and the mind of the students.

(b) As 90 per cent. of the population of India lives in about 7,00,000 villages and maintain themselves by agricultural pursuits, we can roughly conclude that 90 per cent. of the infants and children of the agriculturists pass away their lives in dirty rags, in unclean and unhealthy huts, and playing with mud and dirt. They should be taught to be neat and clean in body, in dress and habitations, and to improve their habits and modes of living. Their toys, plays, pastimes and recreations should be of superior nature. My conviction is that even illiterate persons by proper tutoring can be better educated even without the help of the 3-R's than the school boys who are indirectly compelled, by the fear of being plucked at the examinations, to remember thousands of

unimportant historical facts and events. The power of investigation, reasoning and discrimination cannot be improved by memorization. I do not believe that the children of primary classes are better qualified to be recipients of scientific and technical knowledge, than the illiterate, but *intelligent* children. By mere reading elementary books, writing a few words and learning to add, subtract, multiply and divide numbers, the children are not made better off in intelligence than the illiterate but *intelligent* children. If the above idea of mine is correct, it follows that even illiterate children of villages can be educated in many useful things, also technical arts and sciences by illustrative lectures, without teaching them the 3-R's. The correctness of my theory can be easily tested by educating 100 children without 3-R's and 100 children with 3-R's, for one or two years, and by observing which set makes greater progress. By this simple test the routine work of educating infants of India can be greatly reformed.

(c) The main object of my presenting the above theory is that all boys and girls, of villages or cities, illiterate or literate, should be imparted general knowledge of useful things by means of illustrative lectures. All sorts of opportunities and facilities should be given to them by means of plays and recreations, by showing and explaining to them handiworks, drawings, pictures, models, things of daily use, arts and manufactures, sanitary, chemical, physical, and scientific appliances and exhibits of articles in the three kingdoms, and of modern discoveries and inventions. In most of the English schools of India the students prepare their lessons as routine work in

order to pass in their examinations. This system can be well compared with the injecting of liquid food into the body when natural appetite is absent. The system of education should be so reformed that the students of their own accord shall feel interest and pleasure in gathering knowledge;—their minds should feel hunger and thirst for fresh and nutritive knowledge, by the digestion of which their mind will get nourishment.

(d) It is a good sign of the time that in reformed English schools, cruel corporal punishment has been abolished. I think that in village schools some half-educated teachers severely punish boys with canes and other means. This creates a constant dread in the mind of children and checks the natural unfoldment of their mental faculty; and has bad effects on their physique also. Sixty-five years ago I myself had such experience, when I was ordered to carry two bricks on two hands for five minutes and I had to shed tears on the floor.

(e) Generally children under five years, like the offsprings of lower animals, instinctively develop their limbs and body by their bodily movements. Children above 5 years and below 12 years have a natural tendency to play, and thus they unconsciously develop their body. But as our object is to educate them bodily and mentally during these 7 years, the parents and teachers shall have to regulate their physical plays and devise proper means for unfolding their mental faculties in such a manner that their physical development may not be hampered. In schools and colleges of India only a small percentage of strong elderly boys plays hockey, foot-ball, cricket,

swimming, riding, rowing, gymnastics, high jumps, and similar robust exercises, in imitation of boys of cold countries; but the majority of boys have not means, time or fields, for taking these costly exercises;--nor do they get proper nourishing diet; and a large percentage of them suffers from one or other physical defects or diseases. Reports of sports fill up the columns of daily papers of India; as if the victorious parties have won battles and as if the students are marching onwards in the path of real progress. I think that newspapers should allot more space in publishing records of bodily defects of the large percentage of students and suggestions for their real physical improvement. They should devote at least one column to the subject of health and hygiene, the use of intoxicants (which is one of the greatest causes of the ruin of the nation), immoral habits and the necessity of self-sacrifice for the uplift of the nation. Petty temporary victories in sports are far less important than prosperous health of students and ex-students and their successfully fighting out the keen battle of life. The lot of the generally weak Indian boys,—girls being out of question—of 5 to 12 years of age is far worse off in this respect. Weak children of 10 to 15 years come under this category; but healthy and strong children of that age can join in vigorous exercises and sports. They generally require easy exercises which have less chances of injuries and accidents and which can be provided with little cost. The school and college authorities should deeply think about the above difficulties and obstacles--which should be kept in view in determining their plays; and special devices should be suggested for such

exercises which are light and can be easily taken in schools or at home, either singly or in groups. With a sufficient provision for nourishing diet, I would suggest one thing,--that is, giving prizes to boys or girls who may exhibit better physique and health. Giving prizes to best players is another method of encouragement,--but the former method is superior and more judicious, because in that case all boys who cannot join games are entitled to get the prizes.

Let me present lists of some exercises for the physical and mental culture of these children for the consideration of their well-wishers:--

Physical Exercises.—Running, distant marches, marching in groups with measured steps, patriotic and devotional recitations, comic and jocular plays and farces, mock dramas, singing and dancing singly or in groups, playing on common musical instruments, rope-swinging, sliding on slanting boards, merry-go-rounds, play on horizontal bars about 3½ to 4½ feet high, skipping with ropes, throwing and catching balls, play with bat and ball; *kabaddi, baithak, daunds,* hide and seek, exercises with light bar-bells, dumb-bells and clubs; stilting, jumping, going up and down on ladders, riding on low tricycles or bicycles, balancing of sticks, playing with 2, 3 or 4 balls with both hands, balancing on ropes 1 to 2 ft. high, archery on targets, etc. For boys and girls above 12 years of age, there are more varieties of robust plays and exercises. In books on scouting you will find varieties of special exercises for older boys, out of which some suitable exercises might be selected. Museum should be furnished with illustrated books and charts, and physical appli-

ances and photographs or pictures of actual plays and recreations.

Mental Exercises.—There are several kinds of exercises for the cultivation of the mind, for example,—

(a) Puzzles and curiosities in language, arithmetic, geometry, visual illusions and pictures.

(b) Magic, tricks, fun, caricatures and mimicry.

(c) Wonders and curiosities in physical science.

(d) Mechanical movements exemplified.

(e) Interesting experiments in electricity and magnetism.

(f) Kindergarten system after being Indianized.

(g) Handicrafts.

(h) School exhibits including some of these branches; Handwriting, Drawing, Composition, Designs, Nature Study, Painting, Kindergarten, Works of Art, Toy-making, Scientific Shows.

(i) Botanical specimens.

(j) Useful animal products.

(k) Articles of artistic beauty.

(l) Good handwritings, drawings and charming pictures.

(m) Shows by cinemas and magic lantern of educational scenes.

(n) Showing double pictures by stereoscopes.

(o) Microscopic and telescopic wonders in photographs.

(p) Songs, instrumental music, comic plays, etc. by gramophones.

Details of some of these kinds of educative recreations will be given elsewhere in this book under proper headings.

Some of the other practical means of educating these children are :—

Toy-making, collection and display of leaves, flowers, feathers, insects, butterflies, minerals, stamps, pictures, etc.; playing with mechanical toys; making earthen fruits and vegetables and colouring them; making flowers, toy-houses with furniture and dolls, making decorations, cooking ordinary foods, etc.

(9)

Curious or Wrong Notions about Educational Museums

Not only the general public, but also the educated people have strange or wrong notions, about the nature, utility, classification and cost of Educational Museums. Even the teachers of schools and professors of colleges of India do not care to think about the methods of imparting Education through Museums, because the idea is novel in India. I have imposed upon myself an arduous task of presenting a comprehensive scheme of such a Museum before the heads of educational institutions. Those who feel or take interest in educating the students and the masses, instead of theorising, might form a true idea of it by taking the trouble of visiting and studying the small Educational Museum at Dayalbagh founded in 1919 in connection with the Radhasoami Educational Institute, and developed in course of 17 years. Neither a big, grand building, nor a vast collection of curiosities and antiquated articles alone are the essential requisites of an Educational Museum. Although all museums have some educative value, still according to my views, they do not fulfil the conditions of Educational

Musuems. The *Indian Museum* (of Calcutta) is the biggest Government Museum of India. It was started in 1813 and gradually developed in course of a century. It has a collection of 3,00,000 geological specimens, 21,000 rock specimens, 27,000 vertebrate fossils, a large number of meteorite collections, and hundreds of exhibits in the animal kingdom. There are also a dozen good Museums in India. The main defects in them are,—(1) there are no guides to explain the objects; (2) there is no collection of exhibits in a room for teaching a class there; and (3) there are no elementary guide-books of the different branches of collections.

In order to explain the distinction between an ancient and a modern museum, I am quoting two sentences:—"The aimless collections of curiosities brought together without method or system, were the features of certain famous collections in bygone days." * * "The modern museum, on the other hand, should be organised for the public good, and should be a fruitful source of amusement and instruction to the whole community."

As there are about 5,00,000 varieties of minerals, 5,00,000 varieties of plants and 5,00,000 varieties of animals in the world, it would be almost impossible to collect them in a museum. Moreover, no good purpose would be served by such a collection. Similarly, it would be a futile and fruitless attempt to collect all the activities of the human race in the course of last 5,000 years.

I find the following sentence in the *Encyclopaedia Britanica* (edition of 1910);—"There are now in existence in the world, exclusive of museums of art, not less than 2,000 scientific museums." At the present day, I think, the number might be

double. Let me present before my readers short sketches of some famous museums of London alone. In the book *Museums and the Schools,* published in 1931, it is written that "There are in England and Wales, more than 400 museums accessible to the public,"—school and college museums do not come under this number. Such of my readers as take interest in this subject are requested to peruse Chapter III *Education by Museum* (pages 43 to 53) of my book "*Educational Reformation in India*".

National Museums and Galleries of London

1. *The British Museum.*—It was founded in 1753. It is the largest and oldest National Museum in Great Britain. The Museum also includes the National Library. "The Museum is so vast that days are required to gain an idea of the wonders it contains, and it would take a life-time to become acquainted with them all." The catalogue of books in the Library consists of 2,000 volumes. For publications apply to the Director, Great Russel Street, W. C. 1.

2. *Victoria and Albert Museum* was opened by Queen Victoria and the Prince Consort in 1857. The founders of the Museum had a two-fold aim: to illustrate periods of artistic achievement and to promote the application of art to manufacture. It contains 10 departments thus:—(1) Architecture and Sculpture, (2) Ceramics, (3) Engraving, Illustration and Design, (4) Library and Book production, a reference library containing about 1,65,000 books dealing with the arts and allied subjects and about 2,50,000 photographs, (5) Metal-

work, (6) Paintings, (7) Textiles, (8) Wood-work, (9) Circulation of Objects to provincial museums, local schools of art, secondary schools, training colleges, and technical schools. Collection of Lantern Slides, (10) India Museum is situated in a separate building. It contains collections illustrating the Industrial Arts of India, Ceylon, Afghanistan, Tibet, Siam and Indonesia. For publications apply to the Director, Cromwell Road, South Kensington, S.W.

3. *The National Gallery* contains one of the most important collections of pictures in the world. For publications apply to the Director, Trafalgar Square, W.C. 2.

4. *Tate Gallery* embodies two collections:—(a) The British School and (b) The Modern Foreign School. For publications apply to the Director, Millbank, S.W. 1.

5. *National Portrait Gallery* is devoted to the illustration of British history by authentic portraits of those who have contributed most to its making. For publications apply to the Director, St. Martin's Place, Trafalgar Square, W.C. 2.

6. *Wallace Collection* was bequeathed to the nation by Lady Wallace, who died in 1897 and was first opened as a national Museum by Edward VII, then Prince of Wales, in June 1900. For publications apply to the Director, Hertford House, Manchester Square, W.I.

7. *The London Museum* illustrates the prehistory and history of the London district from the earliest times to the present day, and contains an extensive collection of costumes and personalia associated with the Royal Family. For publications apply to the Keeper, Lancaster House, St. James's, S. W. 1.

8. *The Imperial War Museum* was founded by the War Cabinet in 1917. No attempt is made to glorify war or to emphasize victory over the enemy. A Reference Library containing 60,000 books British and foreign, dealing with all aspects of the war. All exhibits are fully labelled with historical and technical details. For publications apply to the Curator and Secretary, Imperial Institute Road, South Kensington, S. W. 7.

(9) *The Public Record Office Museum* provides accommodation for the national archives which have accumulated since the Norman Conquest, and continues to do so, in the Courts of Law and Government Departments, and provides facilities for their accommodation by the members of the public. The most important exhibits are Domesday Book in two volumes (A.D. 1086), the first specimen of English printing (A.D. 1476), the original anonymous warning which led to the discovery of the Gunpowder Plot, etc. For publications apply to Assistant Keeper, Chancery Lane, W. C. 2.

(10) *British Museum* (*Natural History*) comprises the five Natural History Departments of the British Museum:—Zoology, Entomology, Geology (Palaentology), Mineralogy and Botany. It also includes the finest existing collection of natural history books, periodicals and other publications. Recent accessions;—9,000 bird skins, 3,27,610 Lepidoptera (a kind of insects including butterflies and moths), 100 large cut gemstones of fine quality, including a series of coloured diamonds, herbarium consisting of 40,000 sheets of European plants, etc. This Museum has published beautifully illustrated cheap Guide Books. Complete

list of all publications will be forwarded on application to the Director, Cornwell Road, S.W. 7.

(11) *The Science Museum* is an aid in the study of scientific and technical development, and illustration of the applications of science to technical industry. Many of the exhibits are so arranged that they can be operated by visitors or demonstrated to them. Others have been sectioned so that the internal structure can be clearly seen. A detailed descriptive label is placed by each object. The formation of a Museum of Science was first proposed by the Prince Consort after the Great Exhibition in 1851. The collections of scientific instruments and apparatus were first formed in 1874. The collections are divided into five main groups, two groups being devoted to Physics and Chemistry; and the other three groups to (a) Industrial Machinery and Manufacture; (b) Power Production, Civil Engineering and Land Transport; (c) Air Transport and Water Transport.

In these groups are sections illustrating:—

Mathematics, Astronomy, Time Measurement.

Physics, Electrical, Magnetic, Acoustical, Optical and Thermal Instruments.

Physical Phenomena, Properties of Matter.

Metrology (Weighing and Measuring).

Chemistry (Inorganic and Organic).

Photography and Cinematography.

Meteorology.

Geodesy and Surveying.

Terrestrial Magnetism, Seismology, Gravity, Atmospheric Electricity, and Tidal Phenomena.

Applied Geophysics.

Building Construction, Heating, Water Supply, Sewage Disposal.

Roads, Bridges.

Carts, Carriages, Cycles, and Mechanical Vehicles.

Railway Construction, Locomotives and Rolling Stock.

Steam and Internal Combustion Engines, Land Boilers.

James Watt's Workshop.

Sailing Ships, Merchant Steamers, Steam Ships of War, Small Craft.

Marine Engines and Boilers, and Auxiliary Machinery.

Harbours and Docks.

Aircraft, Aero-engines, and Aircraft Instruments.

Power Transmission, Lifting Appliances.

Pumps, Fire Protection.

Agricultural Machinery.

Textile Machinery.

Mining, Ore Dressing, Metallurgy.

Glass and Pottery.

Hand and Machine Tools.

Papermaking, Typewriting, Printing.

Lighting and Illumination.

Electrical Engineering.

Telegraphy, Telephony, Radio Communications.

There are some historical objects of science, such as, "Rocket" locomotive of 1829 built by George Stephenson, the original magnet of Faraday's experiment, the first power-driven man-carrying aeroplane of 1903, a silver model of an Elizabethan Galleon (c. 1600), a model of the first hydrogen balloon (1783), a 17th century domestic clock, etc.

Children's Gallery.—Here popular scientific experiments are made. Short instructional cinematograph films are shown three times daily.

Special Exhibitions are held from time to time, to illustrate the results of current scientific research in its industrial application. These exhibitions are on view for periods of about three months.

Science Library.—The extensive Science Library contains books, periodicals, transactions, bulletins, etc., both British and Foreign.

Public Lectures are given daily. In addition to the Public Lectures, a special service of lectures, free of charge, is given for the benefit of schools and other organised parties visiting the Museum.

Illustrated handbooks of many of the collections have been published, and others are in course of publication. Apply to Keepers of the Science Museum, South Kensington, S. W. 7.

(12) *Museum of Practical Geology.*—The purpose of the Museum is to illustrate (a) the work of the Geological Survey; (b) the general principles of Geological Science; (c) Economic Geology and Mineralogy. The building was completed in 1933. Earthquakes, mountain-building, weathering, the work of the sea, the action of the rivers, lakes, glaciers and volcanoes, the geology of coal, etc., are explained by photographs, specimens, maps, models, and a series of dioramas (diorama is a scenic representation in which a painting, partly translucent, is seen through an opening with diversity of scenic effect). For publications apply to the Director, Exhibition Road, South Kensington, S.W. 7.

(13) *The Home Office Industrial Museum* provides a permanent exhibition of methods, arrange-

ments, and appliances for promoting the safety, health and welfare of industrial workers employed in factories and workshops, docks and warehouses, and buildings in course of construction. Catalogue, price 4 s., contains a descriptive account of the Museum and its contents; can be had from the Director, Horseferry Road, S.W. 1.

(14) *Royal Botanical Gardens,* Kew, Surrey.—It is 11 miles from London. The main functions of the gardens may be summarised as follows: (1) the advancement of the science of botany and the furtherance of the botanical enterprise throughout the empire; (2) the introduction to the Dominions and Colonies of new plants of economic importance; (3) the illustration of the plant life of the world and the economic uses of plants. The foundation was laid in 1759. For publications apply to the Curator, Kew, Surrey.

Observations.—As it took one or two centuries for the development of some of the above Museums of such a prosperous and ancient city as London with vast Government grants, great munificence of rich citizens and efforts of thousands of persons, it might take 5 to 10 centuries to establish such Museums in poor, uneducated, backward India. The above idea cannot but produce utter hopelessness in our mind in this respect. But my spirit is not damped on that account, because I am all along making suggestions for a modest beginning according to our means and circumstances. If we attempt to compete with grand Museums of a rich foreign country, we must experience failure and disappointment.

Every college and high school of India should

procure a copy of a highly interesting and illustrated book named "Brief Guide to the National Museums and Galleries of London (edition of 1935) by Viscount D'Abernon, Chairman of the Standing Commission on Museums and Galleries, by sending 8 penny stamps (price 6 d. + postage 2 d.) to His Majesty's Stationery Office, Adastral House, Kingsway, London, W. C. 2. In that book are given selected lists of very cheap, popular, useful and interesting guide-books to those Museums and Galleries, illustrated and popular books on arts, industries, sciences, zoology, botany, history, antiquity, literature, fine arts, etc. It is beyond my power to give even a faint idea of the usefulness and educative value of some of these books. They are like the treasures of knowledge presented before the public for the education of the English-knowing people. If *by chance* heads of the schools and colleges of India get even some of these books, the fortunate students can take advantage of these treasures of knowledge and form some idea of how Education through Museum is imparted to the English people in the largest city of the world. I have italicised the words 'by chance', after observing the prevailing apathy towards this natural system of education.

I have given the above list to show that the rich and advanced nations appreciate the importance of museums and liberally spend money on them. Poor India cannot compete with them. It should spend money judiciously according to its means and needs, so that we can derive the greatest benefit possible with the least expense. The spirit of pomp and show should be set aside, and utility and usefulness

should always be kept in view. A college can start an educational museum in its buildings with Rs. 2000, a high school with Rs. 500 and a middle school or a village school with Rs. 100. Even with smaller amounts some useful collections of 8 or 10 kinds can be made in the beginning.

To make the museum successful, teachers and students should take active part. In my book "*Educational Museums at the Educational Centres of India*" you will find details of the costs of an Educational Museum at Calcutta, Patna, Allahabad, Lucknow, Delhi, Lahore, Bombay, Madras, and such big educational centres. Therein you will also find the means of collecting funds by the joint efforts of universities, colleges, schools, municipalities, district boards, and various societies.

(10)

Mass Education in the Indian States

For several centuries Bádshás, Nawábs, Maharajas and Rajas used to keep a number of elephants, horses, bullocks, asses, etc. and chariots, bullock-carts, boats, and other clumsy conveyances for travelling and transit of commodities. But since the introduction of railways, steamers, motor cars, cycles, aeroplanes, etc. in the course of last 75 years, the Rulers and their subjects are naturally taking advantage of these improved conveyances. I have cited the above examples in support of my improved scheme of Education through Museum. I hope that some of the educated Rulers who would read this book, will think over the utility of the improved method

of educating their subjects. Providence has conferred on them the power of ameliorating the condition of their subjects by means of education, by the spreading of arts and industries, by prohibiting the manufacture and sale of intoxicants, and by other methods. The use of intoxicants is one of the principal causes for the degeneracy and wilful loss of the people who have become addicted to the use of some intoxicants on account of the facility given to them by the baneful, nefarious and condemnable traffic, which is ruining millions of people in some civilized countries of the world. It would be a futile attempt on my part to impress on the mind of the Rulers the importance of Museum Education, if they feel any hesitation in accepting my views on prohibition of the immoral traffic, which has been persistently condemned for more than a century by the renowned statesmen, legislators, etc. of England and U.S.A. by presenting statistics and strongest arguments, and by actual prohibition in the U.S.A. This should be an object-lesson to the Rulers and the Government. The Demon of Drink is grinding millions and millions of so-called civilized persons of foreign countries. Even the poor people of India have been sustaining heavy annual losses of about 50 to 70 crores of rupees and suffering from physical and moral degeneration. The members of the Legislative Councils have not successfully fought out this battle of Total Prohibition in India in course of so many years in a country where 95 per cent. of the people would vote for prohibition. The Government are not stopping the traffic by advancing some plausible pleas. But

the case is different in the Indian States if the Rulers feel sympathy for poor, weak-minded, ignorant victims of intoxicants. They can forego the sinful, ill-earned excise revenue. If once prohibition is introduced in a State, and the people are educated in the principles of temperance, it will mean a great pecuniary saving to them; what to speak of the other advantages they will have.

Some critics of the book *Educational Reformation in India* have remarked that there are repetitions of the same ideas. Such mistakes are possible in it, but I think that the nicety of the book lies at least in the repetition of my intentional condemnation of the sinful traffic on intoxicants. Cold iron cannot be bent by a single stroke of a hammer, but by several strokes; whereas red-hot iron can be bent by a single stroke. Sir Wilfred Lawson, a member of the Parliament, could not succeed to bend the mind of the Parliament towards prohibition by 30 strokes in 30 years. Hard heart and solid brain should be first made soft, sanguine and sympathetic by repeated appeals and then some change for the better is possible.

(11)

Children's Museums

"A child's play is no indication of mere frivolity. It is the outward and visible sign of an eager and splendidly directed mental activity." —Dr. Archdoll Reid.

Acting on the above idea all the civilized countries are now teaching their children by means of Kindergarten system. There is

one difficulty in introducing the system in the infant or primary schools of India,—especially in the village schools, because villagers cannot afford to buy the costly materials and tools manufactured in foreign countries for kindergarten instruction. But by a little judicious selection of country materials and tools, it would be an easy affair to teach on these lines.

Boys and girls above 2 or 3 years of age and below 5 or 6 years of age should not be educated along with elder boys and girls. They should be gathered in a separate suitable place of a village under the supervision of a male teacher or an experienced lady for 2 or 3 hours in the morning or at noon, as the season permits. In big crowded cities, where to cross roads is dangerous, it would be difficult to gather infants, although twenty or more householders of a locality of a city can open an infant school. The place selected should be well-lighted and well-ventilated, floor should be dry and neat, and the walls white-washed.

They should be educated by means of such plays and recreations which are calculated to develop their physical or mental faculties. Although option should be given to infants to select their plays, yet they should be mildly dissuaded from such plays as are not conducive to their healthy growth and safety. Pictures and decorations pleasing to the infants should decorate the walls. Dolls and doll-houses, play-things, such as, marbles, tops, balls, small sticks, ropes, toys, cards, beads, small wheels or rings, etc.; light dumb-bells, clubs, springs, and similar articles; toy musical things, as *dholaks*, drums, *bansaris*, bells, cymbals, whistles, flutes, violins,

tambourines, metallic harmonicons, etc. should be collected. Infants should be induced to walk or run in groups, drilled, should recite one or two lines singly or simultaneously, rhythmically and in sing-song tone; should clap, raise or lower their hands, etc. The teacher should play with them or join in their plays. He should be sympathetic, ingenious and dexterous. Educative and pleasing pictures should be collected and shown to them. Mechanically moving and playing toys are generally liked by children. Simple puzzles should be shown to them and they should be solved by the teacher before them. They should be occasionally entertained with sleights of hand, magic, fun, games, magnifying glasses, glass-prisms, kaleidoscopes, stereoscope, curved mirror, sea-saw, gramophones, and a number of similar entertainments, as far as available. Teachers or children should collect flowers, leaves, etc. and arrange them. The pictures of babies, who got prizes for good physiques, and of recreations of English children, should be shown to them. Infants should play the parts of clowns, goblins, bears, etc. by wearing paper masks and dresses to excite laughter or terror. They should be entertained with short educative stories (I am not in favour of senseless nursery tales). Two or four poetical lines (having some meaning) should repeatedly be recited before them for imitation. Once a week the infants should be taught how to wash their mouth, clean or brush their teeth, wash their eyes, nostrils, hairs, armpits and other parts of the body with water or soap-water; to sit erect at all times, even when taking food and going to

privy; how to eat slowly by repeated chewing. They should be repeatedly told common sanitary and hygienic rules. Occasionally picnic parties should be held with light refreshments.

It is superfluous to point out here that a systematic collection of the above-mentioned articles is called Children's Museum. To deny its importance is a proof of the ignorance of the methods of child-education. (In Part I, para. 5 of this book you will find an idea of *Children's Museums* in the U.S.A.)

(12)

Properties of Objects as Perceived by the 5 Sense Organs

As our mind gathers knowledge of the properties of objects by means of 5 sense-organs, I have enumerated the principal sensations in this chapter.

Objects can be roughly divided into two kinds ;—Animate (as horse, tree) and Inanimate (as sand, air). However, in special cases there is no clear line of demarcation between the two.

Inanimate objects are divided into two classes ;—Organic (e.g., ivory and conch) and Inorganic (e.g., salt and water).

Ancients divided objects into five states ;—(1) Solid, (2) Liquid, (3) Gaseous, (4) Caloric and (5) Ethereal. According to modern science, matter has three different states,—solid, liquid and gaseous. As heat can be generated in objects under each of these three states, it is not an independent fourth state. The ethereal state of

matter cannot be perceived by the five senses. Solids have different shapes and sizes, while liquids and gases take up the shapes and sizes of the vessels containing them.

Properties of objects are perceived by the 5 sense-organs ;—eyes see, nose smells, tongue tastes, ears hear and skin perceives temperature, and nerves perceive bodily pain or pleasure. These sense-organs are mere mediums or instruments of perception,—in fact, mind perceives through these senses. Objects have several properties. Some of them are noted here.

Properties Perceived by two or three Senses

Objects are heavy or light, pliable (as copper sheet) or flexible (as cane), fragile or brittle (as glass) ; compressible (as air) ; elastic (rubber) ; subject to chemical union or analysis ; subject to expansion or contraction; interchangeable between solid, liquid and gaseous states by heat or cold ; divisible, porous or impenetrable, malleable, soluble, capable of being contracted or extended ; extensive, smooth or uneven; attractive or repulsive (as magnet or electricity); stationary or moving according to inertia, etc.

Properties Perceived by Touch

Objects are hard, soft, even, rough, pricking, cutting, slippery, pinching, pulling, pushing, pressing, stretching, vibrating, burning, warming, cauterising, rocking, airing, chilly, heating, creeping, tightening, biting, flowing, etc.

Internal Bodily Sensations. — Contusive (wound), tingling (as by light touches or pricking in the armpit), perspiring, throbbing (as of heart),

excruciating (pain from electric shock), giddy or dizzy (in looking downward from a precipice), sensation during a sudden descent from a great height, spasmodic (as in tetanus), convulsive (as in hysteria), belching (by overeating), hiccup or hiccough (in special kind of indigestion), yawning (in laziness), neuralgic (nervous pain), collapsing (before death), drowsy, sleeping, intoxicating, exhilarating, itching, fatigued, soothing, choking, suffocating, gasping, laughing (by inhaling laughing gas), bursting, benumbed (by ice), inflating (of abdomen), paralytic (of any part of body), heavy (in any part of body), shaking (with fear or anger), etc.

Properties Perceived by Smell

Fragrant (rose), putrid (carcass), nauseating (asafoetida), pungent (ammonia), pleasant (eucalyptus), sweet (mango), irritating (capsicum). Some tastes can also be perceived to some extent by the nose; or the minute particles touch the tongue through the nostrils.

N.B.—The most satisfactory classification of smells by the Dutch physiologist Zwoardemaker are the following:—

(1) Ethereal (all fruit odours), (2) Aromatic (camphor, spices, lemon, rose), (3) Fragrant (flowers), (4) Ambrosiac (musk), (5) Alliaceous (garlic, asafoetida, fish), (6) Empyreumatic (tobacco and toast), (7) Hireine (cheese, rancid fat), (8) Virulent (opium), (9) Nauseating (decaying animal matter).

Properties Perceived by Sight

Varieties of Light;—(a) sun-light, (b) moonlight, (c) twilight, (d) lime-light (intense light

produced by incandescence of a piece of lime in an intensely hot flame), (e) search light (a powerful beam of light projected by an apparatus), (f) dazzling (arc-lamp), (g) flashing (lightning), (h) shining (diamond), (i) luminous (glow-worm), (j) illuminating (fire-works), (k) glassy (china), etc.

Effects of Light;—(a) Reflecting (on a mirror), (b) refracting (as in water), (c) transparent (through glass), (d) translucent (through ground glass).

Colours.—Primary Colours,—(1) Red, (2) Blue, and (3) Yellow; Secondary Colours,—(1) Green (Blue + Yellow), (2) Violet (Red + Blue), and (3) Orange (Red + Yellow).

Tertiary Colours are produced by the combination of Primary and Secondary Colours.

Black is the absence of all colours; and White colour arises from special combination of the seven colours of the rainbow;—Violet, Indigo, Blue, Green, Yellow, Orange and Red.

In 1627 the sun's rays were resolved by means of glass-prism by Sir Isaac Newton into 7 colours of light (which are called the seven colours of the rainbow). The 3 neutral colours are:—

1. Black,—composed of equal parts of red, yellow and blue.

2. White,—composed of 5 parts of red, 3 parts of yellow and 8 parts of blue.

3. Grey,—composed of black and white.

There may be several light or deep varieties of the same colour; and innumerable combinations of different colours can be produced. "The human eye is capable of distinguishing 100,000

different colours, or hues, and 20 shades or tints of each hue, making a total of 20,00,000 colour sensations."—Dr. Harold.

Note :—Nine beautiful colour sheets can be had from Wengers, Ltd., Etruria, Stoke-on-Trent, England, at a trifling cost. Ordinary colour-charts can be had from paint-shops.

Properties Perceived by Hearing

Sounds are of two kinds :—

1. Noisy and 2. Musical.

Examples of Noisy sounds ;—(a) Jarring (hammering sound), (b) Vibrating (wire or drum), (c) Explosive or Blasting (gun-fire), (d) Shrieking (by metallic friction), (e) Dolorous (sorrowful or crying), (f) Echoing (in a vault or mountain), (g) Resonating (reverberating in a dome), (h) Cracking (in breaking a wooden stick), (i) Whistling (of a motor car horn), (j) Ringing (of a bell), (k) Bellowing (of bellows), (l) Jerking (sudden unpleasant vibrating sound), (m) Frictional (unoiled carriage wheel), (n) Scratching (metal when turned in a lathe), (o) Roaring (of ocean), (p) Blowing (of wind), (q) Thudding (of railway train), (r) Snoring (in noisy breathing), (s) Tinkling (faint, quick, metallic sound), (t) Exciting (bugle).

Sounds of animals, birds, and insects ;—(a) Roaring (lion), (b) Bellowing (bull), (c) Barking (dog), (d) Bleating (lamb), (e) Mewing (cat); (f) Hissing (serpent), (g) Humming (bee), (h) Rattling (rattle-snake), (i) Chirping (cricket), etc.

Examples of Musical Sounds ;—(a) Melodious (church-bell), (b) Harmonical (piano), (c) Symphonical (concert), (d) Resonant (wire of a musical

instrument), (e) Concordant (band), (f) Sonorous (violin-bow), (g) Soothing (musical tone), (h) Rhythmical (chiming clock), (i) Rippling (gently running water over rough shallows).

Properties Perceived by Taste

(a) Sweet (sugar), (b) Sour or Acid (tamarind), (c) Bitter *(neem)*, (d) Pungent (chilli), (e) कषाय (catechu), (f) Saltish (salt), (g) Tasteless (distilled water).

There are six principal kinds of taste. We can perceive several mixed tastes in fruits, vegetables, etc. Our tongue perceives special sensations, for example, burning (nitric acid), cutting (lime), acrid (alum), cooling (first burning then cooling), curious sensation from electric wire, etc.

Note:—"The German Physiologist, Valentine, could detect bitter at 100,000th solution of quinine."—"*Power of Will.*"

The teacher should explain the above properties by showing some of the objects, which should have been previously collected in the Museum. He can give ideas of the sensations as far as possible, by descriptions, charts, and experiments. To higher class students the seven musical notes can be explained. The teacher should explain the processes of visual and auditory perceptions by showing charts of the eye and the ear. He should show some examples of visual illusions. Ventriloquism, sounds of crickets, rattling snakes, etc. are examples of auditory illusions.

HINTS
ON
MUSEUM EDUCATION

I

PROPERTIES OF ORDINARY FOODS AND DRUGS

By J. C. Basak, Dayalbagh, Agra.

(Reprinted from the "Journal of Ayurveda", August, 1932)

Before describing the properties of foods and drugs, let us consider whether we can remove the defects of the body and mind which we have inherited in this life according to our *sanskar*. It is my belief that if we can form good habits in eating and drinking, we can improve our body and mind to a great extent, so I think that it is our imperative duty to improve our body and mind by culture.

Not only the present medical science, but the old *Ayurveda* system of the Hindus have laid down a number of rules for the improvement of our body and mind. I will now say something about *Ayurveda*. This science has discovered the

three subtle fundamental principles or forces in the body, namely, *Vayu, Pitta and Kapha.* If they are in a state of equilibrium and rightly perform their functions, the body is healthy, but when any one of them preponderates over others and does not act properly, the body becomes diseased. Different foods and drugs act not only on the different organs of the body, but they simultaneously act on these three principles. Climate, temperature, weather and other natural forces also act on these principles.

Half a century ago the allopathic doctors had a crude notion of *Vayu, Pitta* and *Kapha*;—they termed them as 'wind', 'bile' and 'phlegm'. But such are not the real signification of these terms in *Ayurveda*. According to the learned Kabiraj Gananath Sen, M.A., L.M.S., "*Vayu* does not simply mean 'wind' in *Ayurvedic* literature but comprehends all the phenomena of motion which come under the functions of life, or, to be more explicit, the functions of the central or sympathetic nervous system. *Pitta* essentially means 'bile', but signifies as well the function of metabolism and heat-production comprehending in its scope the process of digestion, circulation of blood and formation of various secretions and excretions which are either the means or ends of tissue combustion; and *Kapha* does not mean 'phlegm' merely, but is used primarily to imply the function of cooling and preservation (heat regulation) and secondarily the various preservative fluids, *e.g.*, mucus, synovia, etc., which are the manifest forms of that function."

As all foods, drugs and natural influences act upon the different parts of the body and the three main functions, namely *Vayu, Pitta* and

Kapha also, they act upon eight constituents (*dhátus*) of the body, namely, *rasa* (chyle), *rakta* (blood), *mánsa* (flesh), *meda* (fat), *asthi* (bone), *majjá* (marrow), *sukra* (semen or ovum) and *ojah* (subtle vital fluid).

These actions of the foods and drugs have been divided into four classes:—(1) *Rasa* (taste); (2) *Guna* (Property); (3) *Birya* (influence such as, heat producing or cold producing); (4) *Bipáka* (changes or transformations of the six *rasas* which occur in the stomach on account of the digestive fire). For example, *haritaki* has *kasháya rasa*, but in the stomach this taste is changed into *madhur rasa*, *i. e. sweet taste.*

There are six kinds of *rasas* (tastes):—*madhura* (sweet), *amla* (acid), *lavana* (saltish), *katu* (pungent), *tikta* (bitter), *kasháya* (astringent like the taste of *haritaki*,—Chebulic myrobalum).

(1) The properties of *sweet* things are:—शीतवीर्य्य (cooling), रसादि धातुवर्द्धक (increases the eight constituents of the body), स्तन्यजनक (milk-producing), वलकारक (strength-giving), नेत्र-कण्ठ-हितकर (good for the eyes and the throat), वायु-पित्त-नाशक (pacifier of *váyu* and *pitta*), विषहर (antidotes to poison), पिच्छिल (demulcent or lubricating), स्निग्धताकारक (cooling), प्रीतिजनक (pleasant), आयुवर्द्धक (increasing longevity), पुष्टिकर (nourishing), गुरु (heavy) and भग्नस्थान-संयोजक (joiner of broken parts). It is good for the young, the old, the weak and the injured. It is good for complexion, hair, organs and ओजः (vital fluid). It increases *váyu*, produces स्थूलता (obesity) and

worms. Taking of too much sweet things will produce fever, asthma, गलगण्ड (scrofula), अर्बुद (tumours), indigestion, diabetes and fatty diseases and elephantiasis, occurring on account of preponderance of *Kapha*.

(2) *Acid* things are stomachic, जारक (digestive), killer of *Váyu*, विदाही (burning), क्लेदकर (phlegm producer), tasteful, and outwardly cooling. Too much acids produce lethargy, pus, burning sensation in throat, chest and heart.

(3) Saltish things are digestive, pacifiers of *Váyu*, increase *Pitta* and *Kapha*, क्लेदकर (phlegm producer), bring on idleness, and are antagonistic to other tastes and make the body कोमल (supine). Too much salt produces itching, leprosy, pimples, विसर्प (erysipelas), bad complexion, and वातरक्त (leprosy), रक्तपित्त (hæmatemesis) and अम्लपित्त (dyspepsia with vomiting and purging) diseases.

(4) *Pungent* things are stomachic, digestive, tasteful, pacify *Kapha*, cure obesity, worms, leprosy, itching, nullify the effects of poisons, produce drowsiness (अवसन्नताकारक), increase वातपित्त (rheumatism) and dry up milk, semen, fat, क्लेद phlegm), stool and urine. Use of too much pungent things, brings on भ्रम (giddiness), मत्तता (intoxication), and dryness of गल (throat), तालु (palate) and lips, burning sensation of the body (गात्रदाह) and (बलहानि) weakness.

(5) *Bitter* things increase *Váyu*, but diminish *Pitta* and *Kapha*. They are **रुचिकर** (appetiser), **दीप्तिकर** (digestive), **पाचक** (bile-increaser), decrease thirst, itching, **कोष्ठ** (stool), **मूर्च्छा** (fainting), and fever, and **स्तन्य** (increase milk), **विष्ठा, मूत्र, क्लेद, मेद, वसा च पूय शोधनकर** (rectify stool, urine, phlegm, fat and pus). Too much use of bitter things produces headache, **आक्षेप** (convulsions), **मन्यास्तम्भ** (wry-neck), **भ्रम** (giddiness), **मूर्च्छा** (fainting), and other diseases of *váyu.*

(6) *Kasháya rasa* (astringent) suppresses the passing of stools and urine, flow of blood, **व्रणपूरक** (wound-healer), **स्तम्भकर** (prevents excessive granulations, *lit.* stupefier), **शोधनकर** (purifier), **लेखनकर** (liquefactor, scraper), **पीडनकर** (painful), **रक्तपित्त** (leprosy) and **श्लैष्मा-शान्ति-कारक** (pacifier of leprous and phlegmatic diseases) and increases *váyu*. Too much use of this taste brings on heart-disease, **उदराध्मान** (flatulence), **वाक्रोध** (aphonia), **मन्यास्तम्भ** (wry-neck), **अङ्गोस्फुरण** (exhilaration of the body), **कर्णोन घुम घुम शब्दश्रवण** (tinnitus in the ear), **आक्षेप** (convulsions), paralysis, **अर्दित** (facial paralysis) and such diseases.

I. A.

Ordinary Foods

Next to air and water, food is the most important thing for the preservation of the human frame. It is necessary that we should choose the right sort of the healthy and nourishing food. The subject of diet is very important, because as we have to take food every day, a wrong selection of diet may produce disease. We should know how to prepare food properly, how to preserve it and protect it from insects and microbes. We should also be well-acquainted with hygienic rules about how to eat and when to eat. It is a pity that great ignorance prevails not only amongst children, females and the illiterate people, but even amongst educated persons in these respects. I think 95 per cent of the people are eating and drinking thoughtlessly and indiscriminately. They are generally guided by old habits and customs,—some are slaves to bad habits. In consequence of which they fall a prey to several diseases. The general health of the majority of school boys is pitiable. But the wonder is that schools and colleges do not take any practical steps to change these bad conditions by publishing popular books on diet in vernaculars and English, and teach the students about the properties of common foods and how to make use of them. In my little book "*Diet of the Indians*" 64 rules regarding diet and 25 rules regarding the use of water are given. They should be carefully studied and followed. Water plays a prominent part in the economy of the human body. An elaborate popular book

should be published on the "*Uses of Water in Health and Disease*". Every student should study the book. If I can find space in this book I will devote a few pages on these important subjects.

Quotations

1. Diseases can be cured without medicine, but hundred medicines will not be of any use, if diet is not rectified. —*Maharshi Atri.*

2. More people die from eating too much than from eating too little. —*Napoleon.*

3. Never eat without appetite is a simple physiological maxim. Food is health and medicine to the body. —*Socrates.*

4. Gluttony is the ban of civilization. Gluttony has sent a large number of its votaries to early grave. —"*Experience.*"

5. Oh man! why do you boast so much when you cannot curb your tongue at the table for a few minutes. —"*Experience.*"

6. "Improperly selected food is responsible for a large proportion of human ills, from a simple stomach-ache to the shortening of life itself. In short, food is all-important of the human economy."—Sanitary Engineer-in-charge, United States Public Health Service.

Foods can be broadly divided into the following classes :—

I. Cereals, Pulses and Starchy Foods.
II. Tubers, Vegetables, and Pot-herbs.
III. Fruits, Nuts, Dried and Preserved Fruits.
IV. Milk and its Products.
V. Artificial Foods, Miscellaneous Foods, Invalid Foods.

VI. Eggs, Birds, Fishes and other kinds of Animal Foods.

VII. Baked Foods, Sweetmeats, Confections.

I. CEREALS, PULSES AND STARCHY FOODS

(1) CEREALS

1. RICE:—Oryza Sativa Latin, *Dhánya* Sans., *Chámal* Hindi, *Chául* Beng.—(Unhusked rice is called paddy, *dhán* Hindi and Beng.). Boiled rice, called *bhát* in Hindi and Beng., is a nutritive, strength-giving, easily digestible food,—though it is rather constipating. According to the views of modern doctors, boiled rice has little nutrition; so it should be combined with pulses, vegetables, meat, fish or milk, etc. *Atap* (*árwá* Hindi) rice is more nutritious than *siddha* (par-boiled) rice. Rice one year old is lighter and more wholesome than newly husked rice from paddy. *Dádkhání* rice is more easily digested than other kinds of rice,—it is good for the weak and invalid. There are some 500 or more kinds of rice,—some are coarse, some are fine, some are more nutritious than others, some have good taste and flavour, some have none. Doctors are of opinion that rice husked and polished in power-mills is bereft of vitamin, it causes *Beri-Beri* disease. The very thin layer over unpolished rice contains vitamin A+ and B++. These vitamins are rubbed off when the rice is polished in power-mills. So the home-made unpolished rice which is husked in *dhenki* (domestic wooden mortar and pestle worked by man-power) is preferred. Boiled rice with gruel (*phen* Beng.) is

more nutritive than rice without it, because gruel is nutritive. If rice is boiled with such a quantity of water which is three times in measure of rice the water is absorbed in the rice leaving no gruel. Rice too much softened by boiling is not good for healthy stomach. Half-boiled rice is difficult to digest. Rice boiled in steam as in *cookers* of the present day retains much of its flavour and protein and saline matter, and is more tasteful than the rice boiled in the ordinary method. Boiled rice kept in water for a few hours produces three *doshas.* Boiled rice with its gruel and along with potatoes or other vegetables boiled with rice should be taken with pure *ghee* and a little salt. By taking rice in this manner one does not lose water-soluble vitamins B, C, and the minerals, and vitamin A of pure ghee is not destroyed.

Rice contains enough carbohydrates, but its proteins are not only scanty in amount but are poor in quality. This defect can be put right in the same way as in the case of *átá* (see under 'Wheat'). To supply the necessary protein take some *dál* in addition to the green leafy vegetables and milk or curds or meat or eggs. Rice does not contain enough fat, and, therefore, the rice-diet must contain butter, ghee or vegetable oils ; the first two being the best, because they contain vitamin A in which rice is very deficient. The deficiency of nutrition in water-boiled rice is made up, if rice is boiled in milk. The great fault of rice is that it contains a little vitamin B, this deficiency being greater when rice is milled and polished or when it is par-boiled or much washed.

"All kinds of rice have the same general defects as the other cereal grains,—deficiency of suitable protein, mineral salts and vitamins. But rice has other faults besides.

"(1) It contains less proteins than any other cereal grains, except maize and when it is their main source it has to be eaten in large quantities in order to get enough. The bulkiness of the rice-eater's diet gives rise to two very important consequences: (a) it prevents the proper absorption from the intestines, of the proteins and vitamins contained in the other foods eaten with it such as *dáls*; and (b) it is apt to cause distention of the stomach and bowels, with fermentation of their contents and resultant indigestion and bowel complaints. The remedy is, that one meal of the day should consist of *átá* and the other of rice. (2) "Rice is poorer in mineral salts (calcium, phosphorus, potassium, sodium, etc.) than any other cereal grain used in India. White polished rice is even poorer than white flour in these essential constituents of food. (3) White polished rice contains very little vitamin B and none at all of the vitamins A, C, D." — Compiled from "Food" (by Col. R. Mc Carrison.)

Boiled rice (*bhát*) has water 53 p.c., protein 5 p.c., carbohydrate 42 p.c., fat ·1 p.c., salt ·3 p.c.

"Rice is rich in ferrum salts, starch, etc. and is a good food in diarrhoea, dysentery, fevers, etc. Its pericarp or bran is rich in sodium, potash, and calcium salts and is a good remedy in constipation, dyspepsia, weakness and in some skin diseases." (Dr. V. M. Kulkarni).

Products of Rice

(*a*) *Gruel*, which is left after boiling rice, has some nutrition. It is light, laxative, appetising and useful in biliousness, colic, vomiting, flatulence, dropsy and indigestion.

(*b*) *Infusion of rice*, that is, the water in which rice is kept for some time, is light, astringent, useful in thirst, vomiting, etc.

(*c*) *Khichri* Hindi and *Khichuri* Beng. is the rice boiled with some pulse. This combination supplies the protein, fat and common salt, which are wanting in rice,—because the pulses supplement the wants of rice. If *Khichri* is prepared with too much *ghee* or spices, *bádám* (almond), *pistá*, etc., it becomes difficult to digest.

(*d*) Parched rice (*chál bhájá* and *murhi* Beng. *murmurá* Hindi, puffed rice) are slightly different preparations. Fresh *murhi* or *murhi* preserved in dry vessels or dry place, and which has not become soft on account of moisture, is more easily digested, because it is more puffed up than *chál bhájá*. Saliva can be mixed up with particles of *murhi* if properly chewed. Those who cannot chew, can take powdered *murhi*. The people of Bengal generally eat *murhi* with *gurh* (treacle) or ripe cocoanut. Instead of cocoanut, fried groundnuts can be added. The poorness of protein and fat of puffed rice is made up by groundnut or cocoanut. This mixture is also more tasteful. *Murhi* is heating, bilious, antiphlegmatic, useful in constipation and intestinal worms. The carbohydrate of *murhi* is 82 p. c., but of boiled rice is 42 per cent. *Murhi* has 10 per cent. water, 6 p. c. protein, ·3 p. c. fat, 82·4 p. c. carbohydrate and 1·3 p. c. salt.

(*e*) *Chirá* Beng., *Chiurá* Hindi, *Chipitak* (Sans.), beaten or flattened rice, is more nutritious than boiled rice. It becomes more tasteful and nourishing when soaked in milk or curd, juice of fruits, soup of vegetables or boiled pulse. When softened after being soaked in milk or curd, add a little sugar or ripe plantain, mango or jack fruit to make it a delicious food. If boiled in milk, it is a sufficiently nutritious food. The carbohydrate of flattened rice is 74 p. c., water 8 p. c., protein 9 p. c., salt 3 p. c.

(*f*) *Khai* Beng., *Láoá* Hindi, *Lájá* Sans.—It is produced by frying paddy in burning sand. It is a nutritious food like rice. It is heating, light, easily digestible, nutritious for the healthy, old or dyspeptic persons. The carbohydrate of *Láoá* is 50 p.c. It becomes tasteful if it is soaked in milk, curd, or mango-juice and mixed with sugar. It can be soaked in soup of vegetables or pulses. It decreases urine and excreta.

2. WHEAT:—*Gehun* Hindi, *Gam* Beng., *Godhum* Sans.—Flour of wheat is rich in protein and carbohydrate, but poor in fat and salts. From wheat three kinds of flour are produced,—*átá*, *maydá* and *suji*. *Suji* is the most nutritious of the three. It contains a fairly high proportion of proteins. It is rich in vitamin B, and should be much more widely used in India. *Maydá* produces constipation. The people of the U. P. and Punjab, whose staple food is wheat, make use of *átá* (and not *maydá*) in making *roti*, *chápáti* and *puri*. This is a good selection. The present-day doctors are for wholemeal bread. Wholemeal is a mixture of *átá*, *maydá*, *suji* and some fine bran also. Bran is a natural stimulant to keep the

bowels in proper order. Wholemeal contains double the quantity of lime found in *maydá*. Fermented bread, that is, loaf is easily digested. Biscuits of *maydá* may be good for youngsters and the weak, but wholemeal biscuits are better. Similarly wholemeal loafs are better. Sweetmeats made of dry fried *suji* is less digestible than *háloo*á (Hindi) or *mohanbhog* (Beng.) made of it, because the latter is soft and can be easily salivated. *Suji* boiled in milk is very nutritious. Bread prepared from boiled *suji* (first made into balls by mixing it with water and then boiled in water) is an invalid food. Pastry, puddings, cakes and all fancy bread are not easily digestible.

There are certain defects in the exclusive use of á*t*á. "First defect,—the á*t*á provides enough carbohydrate, but not enough fat. To remove this defect take butter, ghee or animal fat (*charbi*) with á*t*á, because these will provide fuel food and vitamin A as well. Vegetable oils will provide the fat, but not enough vitamin A. Second defect is that the proteins of á*t*á are not good enough nor are there enough of them. To supply this deficiency, take milk or its products, or meat, poultry, liver, fish or eggs. Third defect is its deficiency in vitamin A. To make up this deficiency, we should take milk or its products, or eggs, fish, flesh, liver or green leafy vegetables, which contain vitamin A. Fourth defect is its deficiency in vitamin C. We should add to á*t*á green leafy vegetables or sprouted gram (*chánā*) which contain vitamin C. Fifth defect is deficiency in vitamin D. To rectify this, take milk, butter or ghee or egg, fish oil; or expose the body to sunlight

with an occasional oil-bath. Sixth defect of *átá* is its deficiency in certain mineral elements particularly calcium, sodium and chlorine. The foods to get these are green leafy vegetables, fruit, milk. "It is well to combine *átá* with plenty of vegetables and fruit so that the non-irritating vegetable matter may help the action of the bowels, and the acid-producing tendency of the *átá* may be counteracted by the alkali-producing tendency of the vegetables and fruit."—Compiled from "*Food*". Adulterations.--Flour Mills mix powdered soap-stone, chalk, lime, alum, kaolin, rice, maize, etc.

"Wheat contains all the nutritive salts and phosphates required for the subsistence of human body; calcium, iron, potash, and soda salts, water, fat, starch, albumen, etc., which are required for the human body are in wheat." (Dr. V. M. Kulkarni).

3. BARLEY:—(*Jaw* Hindi, *Jav* Beng. and Sans.)—It very closely resembles wheat in its composition, but differs somewhat in the character of its proteins. The flour of country-barley is cooling, diuretic, strength-giving, appetiser, easily digestible, pacifying thirst. It contains starch, oil and salts. The Vaidyas prescribe it in several diseases, in which wheat-flour is not suitable. *Sátu* or *chhátu* is flour made from parched barley seeds. It is a nice nutritious food when it is mixed with *gurh* or sugar or milk or curd. *Pearl-barley* is the barley-grain deprived of the husk, rounded and polished by rubbing. So-called '*patent barley*' is merely pearl-barley very finely crushed. This refined barley is less nutritive than unrefined barley. Indian barley powder or refined foreign barley boiled in water and mixed with sugar or *misri* (sugar-candy) is invalid food for children

and adults whose digestive power is very weak. Barley breads or biscuits are light and palatable, but slightly nutritive. Barley has about the same nutritive value as whole-wheat, but it contains less gluten and so it is not so easily made into bread. It has vitamins A+, B++.

(*a*) *Malt* (a product of barley) is prepared from the seeds of barley caused to enter into an incipient stage of germination and then dried. Powdered malt in combination with baked wheaten flour in varying proportions forms one of the popular infant-food in England. It may be taken mixed with milk. It is best to give malt two hours after a meal. It then acts powerfully in promoting carbohydrate digestion. The various malt-extracts are chiefly valuable as foods for persons suffering from wasting diseases such as phthisis, as they are easily tolerated by the stomach. Malted milk is largely used in India by the children of the rich. It is a nourishing food.

There are some other cereals and pulses which are used by the Indians, the properties of which are not recorded in books.

4. OATS (*Jai* Hindi).—Of all the cereals real oats rank to wheat as a nutritious article of diet,— it contains nearly 5 times as much fat as wheat. *Oatmeal porridge* is easily digestible, and makes the bowels regular in costiveness. Palatable *Rotis* or *Puris* can be made of half oatmeal and half wheat-flour; they remove constipation. Oats can be taken for long periods without distaste. Oatmeal constitutes a material part of the dietary of the Scotch peasantry. When oats are taken with milk and fish, its deficiency in vitamin A and D are supplied, then it becomes a very nice food.

Oatmeal is rich in food for muscle and brain. Its calories per oz. are 115 (greatest amongst cereal grains). Oatmeal's vitamins are A+, B++.

"Oats contain sodium, potassium, calcium and kalium salts. It is useful for diabetic patients, as it contains sodium salts and less of starch than any other grain." (Dr. V. M. Kulkarni).

5. MAIZE (*Bhuttá* or seeds of *Makái*) also called "Indian Corn". Maize of cold lands is fattening, containing more than 5 times as much oil as is found in wheat. Hominy (maize-flour) of warm land is an excellent food in warm weather. It is an important food in America and Italy. It is a food for brain and muscle. In its nutritive value, maize resembles oats, containing a large quantity of fat. It contains calcium, iron, soda, salts and starch. When made either into cakes or porridge, it affords a valuable food. Good bread can be made by mixing powdered maize with wheat-flour. It is hard of digestion, appetising, tonic, useful in piles and colic. Its proteins are very poor. The yellow corn contains considerably more vitamin A than other cereal grains or than the white variety or gram (*chána*). Its calories are 96 per oz. For this reason it is a very useful *addition* to the food, though as a staple article of diet it is unsuitable. It has vitamins A++, B++.

6. MILLET (*Bájri* Hindi, *Cholum* Tam.) is one of the most nutritious cereals. It contains more vitamin A than wheat. It is rich in vitamin B. It contains soda, lime, iron, salts, etc. It is laxative. It can be chewed and eaten when it is in its juicy condition. It is eaten with rice, milk or milk-products. It would be a very good

diet for the Indians. One meal should consist of rice and another of wheat, *bájri* or *bhuttá*. It has vitamins A +, B + +.

(2) PULSES

7. PULSES (*Dál* Hindi and Beng.) generally are equally nutritious with animal food. *Dáls* contain about twice as much protein as wheat and 4 times as much as polished rice. Their proteins are better than those of the cereal grains, but not so good as those of milk and meat. Vegetarians should invariably eat pulses with rice or wheat flour, for the deficient ingredients of rice or wheat are made up by the pulses. So *khichri* which is rice and *dál* (pulses) mixed up and boiled, is far more nutritious than rice. Germinating pulses are more nutritious and vitaminous than boiled pulses. The Indians generally take boiled pulse along with rice and bread. This is good. Pulses should be properly boiled in slow heat, for it is difficult to digest half-boiled pulses. If one can digest boiled pulses with husks, he should eat them, for they contain more vitamin and will remove constipation. The boiling of pulse in water reduces its content of vitamin B. One ounce of any of the *dáls* contains as much protein as one ounce of meat, nearly twice as much as one ounce of egg and 7 times as much as one ounce of whole-milk." (Col. R. Mc Carrison's "*Food*.")

The Colonel writes:—

"The best way to use pulses is to grind them into meal and to make them into *chápátis* with *átá* or barley or other suitable cereal grains." For rice-eaters, *khichri* is a better food than boiled rice and *dál* separately. Another suitable method of eating *dál* is to grind it with water into a

paste; to make cakes of the paste and fry them a little with oil or ghee; and then boil the cakes in water. Fried or boiled cakes are very nutritious.

"The great difference between the cereal grains and the *dáls* is that whereas a man can eat a pound of *átá*, rice or *rági* (millet) without doing himself anything but good, provided he takes milk and green leafy vegetables with them; he cannot eat a pound of *dál*, peas or beans, as a regular part of his diet, without doing himself harm; because by so doing he would be taking too much protein. And the great difference between the *dáls* and the animal foods, meat, milk, eggs and fish, as sources of protein, is that the proteins of the *dáls* are of the 'less suitable' kind while those of the animal foods are of the 'suitable' kind."—"*Food*", p. 84, 85. It is therefore better to combine both kinds of foods.

"Peas and Beans contain starch, albumen, sulphur, potash and calcium salts. They cause flatulence and uric acid. If taken in small quantities, well masticated and insalivated properly and digested, they are nutritive and strength-giving." (Dr. V. M. Kulkarni).

(8) MASUR—Hindi and Beng., Lentil Eng.—It is a more nutritious food than flesh and is easily digestible. It is a laxative *dál*.

(9) MUNG—Hindi and Beng.—It is more easily digested than any other *dáls*. There are 4 kinds of *mung*,—of which black is the best. Yellow *mung* is tasteful. This is the pulse for invalids and for weak stomach. Germinating *mung* is very nutritious; it contains vitamins A and C.

(10) JOAR (*Cholam*) and *Cambu* are the grains of Southern India. "They are intermediate in

value between wheat which is the best and rice which is the worst of the cereals. They contain twice as much fat as wheat and nearly 15 times as much as rice."—("*Food*"). They are a kind of cereals.

(11) GRAM Eng., *Chánâ* Hindi, *Chholâ* Beng., *Chanak* Sans.—According to Ayurveda it is heating, light and productive of wind. Fried gram is very heating and wind-producing. Boiled gram pacifies *pitta* and *kapha*. If gram be first softened in water and then fried, it is nutritious and stomachic. Unripe soft gram is appetiser, cooling, light, pacifies *pitta* and *kapha*. Germinating gram contains vitamins A and C.

(12) URD Hindi, *Máshkalái* Beng., Kidney Bean Eng.—It is laxative and increases urine, fat and bile, is good for colic and fistula. It is good in gastritis, gastric ulcer, dysentery and diarrhoea. It is the demulcent and cooling *dál*. The bluish coat should be retained in cooking, because it contains vitamins; and the patient should take only the clear mucilaginous decoction.

(13) MATAR Hindi and Beng., Field-pea Eng. Light, heating, pacifies *pitta* and *kapha*. The soft young green grains are eaten raw or cooked.

(14) SEM Hindi, *Sim* Beng., a kind of Bean Eng., is a rich source of proteins, which are of fairly good quality. There are two kinds, white and black. It is rich in fats and vitamin B. It is above other pulses as an albuminous food. Indians generally cook soft green beans with or without covers as vegetables.

(15) ARHAR Hindi and Beng., Pigeon-pea Eng.—Light, increases *váyu*, pacifies *pitta* and *kapha*.

(16) LOBIA Hindi, *Barbati* Beng., Cane-pea or Chinese dolicas.—It is strengthening and laxative.

(17) KHESARI Hindi and Beng.—Very heating, appetiser, decreases *pitta* and *kapha*.

(18) SOYABEAN (a kind of bean), is highly nutritious food. Its food-value is higher than that of any flesh food. The biological value of its protein is very high. It contains vitamins A, B and D. It is practically free from starch. The carbohydrates are in the form of simple sugar. The ash is very rich in potash, calcium and phosphorus.

Comparison of 4 kinds of foods.

	Protein p. c.	Fat p. c.	Calories
Buffalo milk	4·0	7 to 9	480
Egg	14·8	10·5	720
Meat	24	2·5	576
Soyabean	46	20·3	2,100

(3) STARCHY FOODS

(19) SAGO is a starch from various species of palms. Sago is an easily digestible and wholesome food for the invalids. It is a mucilaginous bland food, for it has no nitrogenous constituents. Most people do not know that pilules or globules made from *Cassava* plant are sold as sago in the market. Real sago is quite a different article. Sago is another starchy food obtained from the interior of sago-palm grown in Sumatra. Of all starchy foods sago is most commonly prescribed in dyspepsia, diarrhoea, dysentery and fever. But it is a pity that the doctors do not insist on the use of genuine sago. It is better to substitute *sati-food* for so-called *false sago*. Sago contains 80 p.c. starch, it has no vitamin, its calories are 97.

(20) ARROWROOT is a white, tasteless, odourless powder made from root-like stems of two kinds of Indian plants. It is a pure starch, and has not much dietetic value. It is chiefly used as a smooth and soothing article of food for invalids and little children. It is cooling, demulcent, and is useful in dysentery, ulceration of the bowels, etc.

(21) TAPIOCA or *Cassava* is also a starchy food in the form of granules. It is prepared from the roots of *Cassava* growing in Brazil. It is also cultivated in India, Africa and other tropical countries. The *Cassava* pulp dried on hot plates forms irregular little lumps, which are called *Tapioca*. It can be kept in water for an hour or two to soften it and then boiled in milk with sugar. It becomes good pulpy food for the healthy. It has no vitamin, but its calories are 100.

(22) SATI-FLOUR Beng., *Kachur* Hindi, *Curcuma Gedoario* medical name.—*Sati-flour* is made from the tuber of a plant *Trikhut* (Beng.) produced in Bengal. It is in use for hundreds of years. In Ayurveda it is highly valued. It is a nutritious and tasteful food. It should be boiled in milk and mixed with sugar. Its analysis is,—19·8 water, 3·36 protein, 3·6 fat, 75·36 carbohydrate, 1·3 salts. It is light, appetiser, tasteful, cures piles, worms, indigestion, pacifies *váyu* and *kapha*. It is a wholesome light food in all diseases, dryness of the mouth, colic, piles, flatulence, etc.

(23) CORN-FLOUR or Indian Corn-flour is obtained from Indian corn (maize). Indian corn-meal contains nitrogenous substances 13 p.c., starch etc. 60·5 p.c., fat 7 p.c. Thus you see that maize-meal contains a much larger quantity of nutritive

material than all other cereals, oat-meal alone excepted. By various methods of manufacture the presence of a bitter principle and nitrogenous constituents in the maize-meal are removed, leaving only the starch of the grain in the form of a fine white powder called *Corn-flour.*

II. TUBERS, VEGETABLES & POT-HERBS

TUBERS are a kind of short fleshy underground stems or shoots, as the potatoes. Bulbs are similar to tubers, they are subterraneous large buds emitting roots from below. Tubers and bulbs are also called root-vegetables. "Some of the tubers and root-vegetables, such as potato, are rich in carbohydrate (starches or sugars) and are therefore good sources of 'fuel-food'. They are also good sources of mineral elements. They contain less vitamin B than the cereal grains and very little vitamin A, except those that are of a yellow colour, such as carrots and sweet potatoes. All yellow or yellowish-red vegetables, whether roots or other parts of the plant, contain more vitamin A than white vegetables or white parts of vegetables. All root-vegetables contain some vitamin C, which is, of course, largely destroyed when they are boiled."—("*Food*", p. 89).

(1) TUBERS

1. POTATO, Á*lú* Hindi and Beng.—It is largely used by the Indians throughout the year. It contains citric acid, potash salts, phosphoric acid. It has a large proportion of starch with very little protein. It is a carbohydrate food and destroyer of scurvy. If it is boiled a little with skin it con-

tains vitamins A + (very little), B+, C+++. The skin can be separated after boiling. The skin might act as roughage in constipation. It is palatable, heavy, very nutritious, increases urine and stool. It is bad for acid dyspepsia, but good in neurotic and liver dyspepsia. Its calories per oz. are 36, which are greater than all other tuber and root vegetables, except garlic whose caloric value is 40. It has 74 p. c. water, 2 p. c. protein, ·16 p.c. fat, 21 p. c. carbohydrate and 1 p. c. salt.

2. SWEET POTATO.—It has two varieties, white and red,—called *Sakar-kandi* Hindi, *Mitha álú* and *Rángá álú* Beng.—It is cooling, slightly laxative, heavy, wholesome and nutritious. It contains 3 p.c. sugar, which the potato does not possess.

3. CARROT, *Gajar*, Hindi and Beng.—Heating, digestive, useful in piles, purifies blood and corrects biliousness. It has vitamins A+ to ++, B++, C+ to ++ and contains iron. This vegetable is not much used by Indians, but as it is very rich in vitamins, its use should be more popularised. "Carrot contains silicea, calcium and sodium salts and is useful for gouty patients as it eliminates uric acid from the system. It brings the liver in proper order and cures gall-stone troubles."

4. RADISH, *Muli* Hindi, *Mulá* Beng.—Small-sized radish is tasteful, digestive, heating, pacifies *tridosh*. It is rich in soda. It is a remedy for piles, colic, constipation, and gall-stones. Big ones are heavy, heating, and producer of 3 *doshas*. Raw radish is not suitable for weak stomach. It has 10 calories, and vitamins A (very little), B+, C+.

5. TURNIP, *Salgam* Hindi and Beng. If boiled well, it can be digested easily. It has 7 calories, and vitamins A (very little), B+, C+. It contains

sulphur, potassium, and sodium salts; so it is aperient and diuretic.

6. SURAN Hindi and Sans., *Zimikand* Hindi, *Ol* Beng., Arum companulatum Eng.—It is a useful food, specially in piles, and also in spleen diseases. Some wild-grown varieties are very irritating to the tongue, mouth and digestive organs, even when thoroughly boiled. Everybody should take care to avoid them.

7. MAN or *Mánkachu* Beng.—It is a big vegetable from 5 seers to 1 maund. It is cooling, light, laxative, increases milk and urine, and very useful in dropsy and biliousness. It purifies the blood. Some of them are very irritating to the mouth and alimentary canal. They should be avoided. Dried and powdered *mán* is a light food for invalids. It is made into gruel by boiling the powder made from dried chips of *mán*. Two parts of this powder and one part of *átap* rice should be boiled in water and mixed with sugar. Powder of *mán* fried in *ghee* and mixed with sugar makes a good sweetmeat.

8. KACHU Beng., *Arwi* Hindi.—It is a good vegetable food. The irritating ones should be eschewed.

9. BEET ROOT, *Chukandar* Hindi, *Beet pálang* Beng.—It contains more sugar (10 p. c.) and therefore is more heating than other vegetables. Sugar made from it is called *beet-sugar*. This is often taken raw as salad. It is an easily digestible and nutritious food. It has vitamins B+ and C+.

10. ONION Eng., *Piyáz* Hindi and Beng., *Palándu* Sans.—It is stimulant, diuretic and expectorant. Its caloric value is 14. It has vitamins B++, C+.

Onion is amongst the most valuable of all vegetables. In addition to its food value, it is a powerful antiseptic. "Onions contain sulphur, phosphorus, potassium salts, ammonia, phosphoric and acetic acids, citrate of lime, starch, sugar, ligumine and volatile oil, etc. They are a household remedy for cough, bronchitis, scanty urine, colds, influenza, liver troubles, inflammatory conditions, gout, rheumatism, etc.; they promote perspiration and circulation of blood."

11. GARLIC, *Lasún* Hindi, Beng. and Sans.—Heating, alterative, nutritious, antiseptic, stimulant, tonic article. It cures indigestion, loss of appetite, constipation, piles, dropsy, flatulence and worms. It contains some strong odoured acid. It cures obstinate sores and tuberculosis. Taken raw with common salt it relieves colic.

(2) VEGETABLES

12. KARELA Hindi and Beng. (big bitter gourd) and *Uchche* Beng. (small bitter gourd).—They are stomachic and tonic. They should be eaten in liver and spleen diseases, constipation, jaundice, fever, diabetes and intestinal worms.

13. JHINGA Beng., *Turai* Hindi, Sponge Gourd Eng. is cooling, light, wholesome and useful in constipation and flatulence.

14. KANKUR (unripe *phuti* Beng., *Phut* Hindi) is used as a vegetable.—It is heavy, cooling, tasteful and increases excreta.

15. BRINJAL or Egg-plant, *Begun* Hindi and Beng. is digestive and carminative, young fruit is antiphlegmatic, antibilious and carminative. Ripe fruit is bilious. Being roasted in fire it becomes laxative, light and slightly bilious. It is appetising

and wind-relieving. It is a safe food in most forms of dyspepsia. It is best eaten by roasting it in very hot ashes.

16. PARWAL Hindi, *Patol* Beng. and Sans.—It is a light wholesome food, especially suited for the convalescent. It is appetiser, has cooling effect on the stomach, kills intestinal worms, and removes constipation. It is febrifuge and useful in bilious fever. It suppresses the three *doshas.* The young fruits boiled, fried or roasted are easily digested by the dyspeptic. For Leaves of *Parwal* see no. 42 *Ság.*

17. SAJINA Beng., *Sahinjan* Hindi, *Sobhánjan* Sans., Horse-radish Eng.—The fruits and flowers are eaten as vegetables. They are stomachic, anti-colic, can be used with advantage in spleen-disease. The fruits are digestive, anti-phlegmatic and anti-bilious.

18. BHINDI or *Rámtorai* Hindi, *Dhenras* Beng. Lady's finger Eng., is a valuable demulcent. It is mucilageous (secreting sticky substance) and nourishing. It is used in constipation, dysentery, catarrhal condition of the stomach and bowels. It is cooling and useful in gravel.

19. JACKFRUIT.—Unripe jackfruit, *Enchor* Beng., *Káchchá Kátahár* Hindi.—Hard of digestion, but nutritious. Seeds of ripe jackfruits are hard of digestion, but nutritious, diuretic, astringent, increasing flatulence. They are tasteful vegetable. Their calories are 54.

20. CHALTA Beng., *Lásorá* Hindi, Sebastian fruit Eng.—Efficacious in biliousness.

21. TOMATOES are the richest of all foods in vitamins, most effective blood-cleansers, and the richest of all vegetables in the natural health acids

which keep our stomach and intestines in proper condition. It contains vitamins A+ +, B+ + +, C+ + +. Its calories are 6. When eaten in sufficient amount, it is a sure protection against beri-beri and scurvy. Weight for weight, tomatoes, raw or steamed, rank with lettuce or string beans as a source of vitamins A and B and with orange and lemons as a source of vitamin C. The dry matter of tomatoes and of spinach contains an even higher concentration of vitamin A than does butter-fat. Special emphasis may well be given to the anti-scurvy value of tomatoes and of tomato-juice, because these contain their vitamin C-content almost unchanged in cooking.

The value of tomato juice has been recognised for a considerable time by the medical profession as one of the most successful remedies for rickets and scurvy, but it is only recently that it has become generally accepted as the chief remedy for malnutrition for children and invalids. Several cases of ophthalmia, an eye-disorder caused by a diet deficient in vitamin A, have been treated by giving tomato-juice. It has been stated by a noted authority on diet that tomatoes and tomato-juice afford great protection against disease of any single item of diet in the world. Yet it is surprising how slow the public is to accept anything so simple and so inexpensive as tomatoes. The juice also should be given to patients suffering from fever, as the natural acids counteract the feverish condition of the system and afford greater relief than almost any other beverage." Tomatoes are laxative and are therefore useful for persons suffering from constipation. But tomatoes should not be eaten by persons suffering

from hyper-acidity and gout. Tomato-juice is one of the thirst-quenching beverages. Tomato is good in diabetes; it reduces weight, overcomes the toxin from too much food and too little exercise. It contains proteins, phosphates, citric and malic acids, calcium, phosphates of iron, potash, lime, magnesium, sodium, sulphur, sugar, chlorine and iron.

22. UNRIPE PLANTAIN, *Kánch-kalá* Beng. is a nice vegetable food. It is cooling, astringent, pacifies *kapha*, nutritive, phlegmatic, heavy. It is prescribed by the Vaidyas to the convalescent.

23. PETHA Hindi, *Kumrá* Beng., White-gourd Eng.—Young fruit is cooling, phlegmatic, antibilious, carminative. Ripe fruit is light, digestive and useful in liver-diseases. Sweetmeats made from it are widely used in India.

24. KASHIFAL—Yellowish red gourd, *Kashifal* Hindi, *Biláti Kumráh* Beng. is quite different from the white gourd. It is heating, hard of digestion, causing indigestion. The kernels of its seeds are good to eat.

25. LAUKI Hindi, *Láu* Beng., Bottle-gourd Eng.—Refreshing, appetising, phlegmatic, antibilious, nutritious.

26. CHICHINDA Hindi, *Chichingá* Beng., Snake gourd Eng.—Cooling, appetising, useful in disorders of the liver.

27. TAROI Hindi, *Dhundul* Beng., Luffa Eng.—Useful in diseases of bile.

28. DUMUR Beng., Green Figs Eng.—Cooling, slightly bitter, astringent, useful in cold, biliousness, piles and jaundice. (b) *Gullar* Hindi, *Yajna-dumur* Beng. (Big variety).—Young fruit is astringent and

useful in biliousness and vomiting. Ripe fruits are sweet, cooling, useful in biliousness.

29. SEM Hindi, *Sim* Beng., Country-beans Eng.—Heating, nutritious, hard of digestion.

(3) POT-HERBS

30. THORH (Beng.), innermost stem of plantain tree, is cooling and appetiser. Useful in acidity and biliousness.

31. MOCHA Beng. (flowers of plantain) is cooling, but not easily digested. It pacifies *váyu* and *pitta*. It is good in acidity, antibilious, carminative and a nice diet in diseases of the spleen and liver.

32. UNRIPE GREEN PULSES (*Dáls*) such as, grams, peas, etc., with leaves are eaten by the people either raw or cooked. They serve the purpose of green leafy vegetables. When they are green, starch is not formed, and therefore less nutritious than when they are ripe. During the growth of plants, sugar is first formed, so that in all green vegetables what little of carbonaceous food is obtained, is in the form of sugar, which is converted into starch as the plant progresses, and when the grains or leguminous seeds are perfected, very little sugar is left, and starch is prominent. But in fruits, the sugar increases as they ripen, and, when perfectly matured, sugar is the principal constituent of nourishment.

POT-HERBS, *Ság* Hindi and Beng.—These are edible leaves of plants, such as, cabbage, lettuce, spinach. They should be steamed or boiled with as little water as possible till quite soft and the water absorbed in it. Very little spices should be used. They are blood purifying and valuable on account of their waste element, but

they are neither nutritious nor stimulating. Raw pot-herbs are more vitalizing than cooked green stuff, but cooked ones are more laxative.

33. KALMI SAG Hindi and Beng.—Cooling and laxative.

34. AMRUL SAG Hindi and Beng., Sorrel Eng.—The leaves are cooling and useful in loss of appetite. It is antiscorbutic.

35. CABBAGES leaves of *Band Gobi* Hindi, *Bándá Kapi* Beng.—Hard of digestion, poor in nutrition and unsuited to dyspeptics ; but cabbage is a rich source of vitamins. It contains sulphur, soda and iron. It is useful for coughs, bronchitis, asthma and some skin diseases. Cauliflower, *Gobi* Hindi, *Fulkapi* Beng., contains 92 per cent. water, ·5 p. c. protein, fat 0 p. c., carbohydrate 2 p. c., salts ·7 p. c. It has vitamins A+, B++, C+.

36. BATHUA Hindi, *Betho* Beng.—Easily digestible, stomachic, useful in spleen, piles and intestinal worms.

37. PODINA Hindi and Beng., *Rochani* Sans. (meaning producing desire for food).— Digestive, tonic, useful in vomiting and distaste for all foods.

38. PALAG Hindi, *Pálang* Beng., *Pálanka* Sans., Spinach Eng.—Heavy, laxative, phlegmatic, increases *váyu*. This is also a rich source of vitamins A+, C+, it is very rich in iron.

39. BRAHMI Hindi, Sans., and Beng.—It is laxative, cures jaundice and dropsy.

40. HINCHE or *Helencha* Beng., *Hurhul* Hindi, is cooling and aperient, useful in biliousness, dropsy and catarrh.

41. PAT-SAG, leaves of jute plant.—In diseases of the bile, infusion of dried *pat-sag* (also called *nálte* in Bengal) is useful. Soups or curry made by mixing

it with other vegetables are made in Bengal and are used with rice. The bitter infusion of it with a little salt is used as a domestic remedy in atonic dropsy and fever.

42. PALTA SAG are Leaves of *Parwal* Hindi, *Patol* Beng.—They are cooked with other vegetables to reduce their bitter taste. It is stomachic, digestive, cooling, and useful in biliousness, consumptive fever and worms. The *Vaidyas* prescribe the soup of *paltá* in disorders of bile. It stimulates liver and secretion of bile.

43. PUIN SAG Beng., Red-night-shade Eng.—It pacifies *váyu* and *pitta*, is nutritive, appetiser.

44. CELERY (i. e. leaves of *Ajmod* Hindi, *Rándhuni* or *Chandani* Beng.)—It is heating, light, appetising, stomachic, astringent and anti-phlegmatic. It contains iron and sulphur. The stems and leaf stocks are generally eaten by the Europeans.

45. NEEM LEAVES and Flowers are used by frying with oil or ghee, or making soup with vegetables. They are blood purifier, kill intestinal worms, pacify *pitta*, revive lost taste for foods, cure leprosy. Leaves are antiseptic and cure skin-diseases by application.

46. RADISH LEAVES (*Muli Ság*) as food is stomachic. Fresh juice of the leaves is diuretic and laxative.

III. FRUITS, NUTS, DRIED AND PRESERVED FRUITS

"Fruits and Berries serve some of the same purposes as green leafy vegetables. They are amongst the best of the foodstuffs and should form a considerable part of our daily diet. They

contain much mineral salts of the alkaline kind which keep the blood pure and prevent it from becoming acid or sour. Fruits are very useful in keeping the bowels healthy and active."—"*Food*", p. 88. The Nuts are rich in protein and should be consumed in place of meat and fish by the vegetarians.

1. MANGO, *Am* Hindi and Beng.—It is called 'the king among fruits' on account of its taste and flavour. In Sanskrit it is called *Amrita Phala* (nectar fruit). It contains sugar, iron, and useful acid. It is useful in rheumatism, diabetes, etc. The unripe fruit is acid and astringent; it produces three *doshas*. The ripe fruit is slightly laxative, nutritious, phlegmatic, invigorating and fattening. It pacifies *váyu* and *pitta*. It is a rich source of vitamins according to the "Lister Institute" of London. 'Alphonso' variety is extremely rich in vitamins. It contains 6 times as much vitamin C as the best variety of apple known. Two other varieties of mango showed less quantities of vitamins. Its caloric value is 23, which is higher than that of other fresh fruits. Dried pulp of mangoes is largely used by the Indians. It is called *ámábat* Hindi, *ámsatwa* Beng. It has some of the properties of mangoes, but probably the vitamins are lost by preserving it for a long time.

2. GRAPES OR VINE, *Drákshá* Sans., *Angúr* Hindi and Beng.—Ripe grapes are laxative, cooling, diuretic, phlegmatic, producing wind, tasteful, and tonic. They have vitamin B+, and also vitamin C, calories being 17.

"Grapes are rich in sugar called glucose; they contain tannin, gum, tartrate of lime, magnesia, alum, iron, chloride of potash and soda, tartaric,

citric and malic acids, etc. The rind or skin of grapes is astringent and constipating and the juice and pulp are laxative and they allay thirst. They are useful for children during teething and whenever they are constipated. They promote flow of urine and are useful in gout and rheumatism. Cancer patients will do well by eating a large quantity of them."—(Dr. V. M. Kulkarni).

3. TAMARIND, *Amlika* Sans., *Imli* Hindi, *Tentul* Beng.—The ripe fruit is cooling, allaying thirst, heat and fever; digestive, carminative, anti-bilious and laxative. The people generally use it in preparing acid soups or curry mixing a little sugar with it. It becomes dry after a year. It has vitamin B+ and C+. Old dried tamarind of several years has great medicinal value. Unripe tamarind is hard of digestion, carminative, bilious, and phlegmatic.

4. JAMAN Hindi, *Kálajám* Beng., Jambul Eng. —It contains sodium salts and sugar and are useful for diabetes mellitus. The juice of the ripe fruit is stomachic, carminative and diuretic. Ripe black-berries are good in atonic dyspepsia if taken after meals. Its juice is preserved in bottles and is given in dyspepsia.

5. GUAVA.—*Amrúd* Hindi, *Peyárá* Beng.—The ripe fruits are sweet, but a little acid. It is nutritive, tasteful and refreshing. It is laxative, specially on account of its seeds.

6. POMEGRANATE, *Anár* Hindi, *Bedáná* or *Dálim* Beng., *Dárimba* Sans.—Sweet ones appease thirst, fever and burning sensation. It is astringent. The fruits are of 3 kinds, sweet, sour, and sweet-sour. The juice of the sweet ones is a refreshing drink for the invalids. Its calories are 2, and

vitamins are B+, C+. It contains sugar, potash, and sodium salts. It is useful in diarrhoea and dysentery.

7. KAMRAK Hindi, *Kámrángá* Beng.–Cooling, refreshing, anti-scorbutic, astringent and useful in biliousness.

8. SUGARCANE, *Ganná* or *Pondá* Hindi, *Ák* Beng.– It is not a fruit, but only a stem. But it has properties of fruits. The juice is nutritive, laxative, demulcent, antiseptic, preservative, and diuretic. It has a cooling effect, pacifies *pitta*, but increases *kapha*. If small pieces of sugarcane be pressed with the teeth and the juice is sucked, it has the best effect,—teeth have exercise and the mixing of saliva is obtained.

Products of Sugarcane

(A) GURH Hindi and Beng., Jaggery Eng.,—is the first production. It is heavy, tonic, cooling, pacifies *váyu*, increases *kapha* and intestinal worms. If taken with fresh ginger, it pacifies *pitta*, and if taken with dried ginger it pacifies *váyu*. *Gurh* of at least 3 years old is light, digestive, antibilious, cooling, and is indicated against colic, piles, loss of appetite and diseases of the spleen and liver. Gurh contains vitamins and mineral matters which are lost during the process of manufacture of sugar. Hence from the nutritional point of view *gurh* (Indian molasses) is to be preferred to white sugar.

(B) SUGAR, *Chini* Hindi and Beng.—It pacifies *váyu* and vomiting.

(C) MISRI is more refined than *sugar* and is generally sold in crystallised form. It is cooling and light food for the sick. A piece of *misri* kept in the mouth relieves hiccough and irritation of

the throat. It is stimulant, it diminishes dryness of the mouth, allays irritation, and mitigates cough and hoarseness. It promotes digestion and allays nervous excitement. A strong solution of sugar is an antidote to corrosive poisons. It is antiseptic like boric acid, and is antacid like soda. Taken in empty stomach, it increases the flow of gastric-juice.

Products of sugarcane have carbohydrates from 25 to 28 p. c., and calories 100 to 113.

9. COCOANUT, *Nárikel* Beng., *Náriel* Hindi.—Its soft pulp is effective in bilious fever and mucous disorder. Mature kernel is hard of digestion, but useful in thirst and dryness of the tongue. Ripe hard kernel is not easily digested and is bilious. Water of the young fruit is light, cooling, antacid, digestive, nourishing, refreshing, stimulant, and useful in diseases of the bile and blood. Water of the ripe fruit is hard of digestion, palatable, nutritious, digestive and laxative.

"Cocoanut contains phosphates of calcium, iron, potash and soda; it also contains milky and oily substance, albumen, and a little starch. It is very easily assimilated; more easily than milk and codliver oil. The weak and the tubercular patients can safely make use of it both as food and general tonic."—(Dr. V. M. Kulkarni).

10. JACKFRUIT, *Kántál* Beng., *Káthár* Hindi.—Ripe fruit is hard of digestion, nutritious, phlegmatic, laxative, useful in biliousness. It is rich in vegetable protein, sugar, albumen, calcium and soda salts.

11. CUSTARD APPLE, *Atá* Beng., *Sharifá* Hindi.—Cooling, phlegmatic, useful in costiveness and diseases of the bile. "Custard-apple contains soda,

potash, sulphur and sugar. The pulp prepared from its leaves cures obstinate boils and carbuncles."

12. CUCUMBER, *Khirá* Hindi, *Snasá* Beng.—Cooling, hard of digestion, diuretic, blood-purifying, and valuable for waste elements. It is neither nutritious nor stimulating.

13. DATE, *Khajúr* Hindi and Beng.—Hard of digestion, not good in dysentery, flatulence and vomiting. Indian dates are small, poor in quality. Dates of Arabia are pulpy and sweet, contain 65 p. c. carbohydrates (starch, sugar, etc.), calories are 81, vitamin B+. Treacle made from the juice of date tree is tasteful and has a good flavour. "Arabian dates contain 20 per cent of pure sugar and some valuable phosphates, chiefly of iron. They prevent constipation and soothe the heart."

14. PALMYRA, *Tál* Beng., *Tárh* Hindi.--Soft kernel of the stone of unripe fruit is cooling, demulcent, hard of digestion, nutritious and useful in biliousness. Water within the soft kernel is sweet, cooling, diuretic, antibilious, and useful in hiccough and vomiting. Yellow sticky juice of the fibrous part of the ripe fruit is hard of digestion, nutritious, diuretic. The jaggery or *gurh* and *misri* made from the juice of palmyra tree are more delicious and efficacious than those made from sugarcane juice.

15. BANANA or Plantain (of two different kinds), *Kalá* Beng., *Kelá* Hindi.—Sweet ripe fruits are cooling, nutritious and laxative (if taken in the morning). Ripe plantain being free from acidity is good for delicate stomachs. It is used as a mild demulcent and astringent diet in dysentery. Flour made of green plantain dried in the sun is used in the form of *roties* in cases of dyspepsia

attended with troublesome flatulence and acidity. It is a good source of all mineral salts. It has a good percentage of carbohydrate, i. e., energy producing food. It contains phosphorus, iron, soda, albumen, starch, etc. The red plantain contains more of iron and sugar and is good for anaemia and general debility; the yellow contains more of soda and is useful for constipation; the green contains more of potash and soda and is diuretic. It has vitamins B+, C+. There are several kinds of plantains; some are sweeter than others. It contains water 75 p. c., protein 1·5 p.c., fat ·5 p.c., carbohydrate 22 p.c., minerals ·8 p.c., calories per oz. are 28.

16. AMRA Beng. and Hindi, Hog Plum Eng.—Ripe fruit is cooling, palatable, nutritious, astringent, phlegmatic and carminative. It is useful in bilious dyspepsia, hence it is called *pitta-brikṣha* (bile-tree). It is also used as an acid vegetable.

17. JUJUBE or Plum, *Ber* Hindi, *Kúl* Beng.–Acid-sweet green fruits are cooling, anti-scorbutic and carminative. Ripe fruits are demulcent, laxative, carminative. Dried fruits are light, demulcent and stimulant. It contains potassium salts and sugar. Sweet plums have no anti-scorbutic or carminative properties.

18. KESUR Beng., *Kaseru* Hindi.—It is a tuber. It is eaten raw. Cooling, hard of digestion. Its juice is easily digested. It pacifies *váyu* and *kaph*. *Kesur* indented from the islands of the Indian sea is softer and sweeter.

19. MAKHANA Hindi, *Makhánna* Sans., Euryeli ferox Latin.—It is produced from seeds of a water-plant by frying them. It is cooling, astringent, increases *váyu* and *kaph*.

20. SINGHARHA Hindi, *Pánifal* Beng., Water-caltrop Eng.—When a little ripe, it is cooling, heavy, nutritious, astringent. When they are fully ripe and are dried, they are powdered into flour, and sweetmeats are made of it.

21. TUT Beng., *Shahtút* Hindi, Mulberry Eng.—Ripe fruits are heavy and laxative.

22. TARMUJ Beng. and Hindi, Water-melon Eng. —Heating, alkaline, bilious, carminative, anti-phlegmatic, calories 9, vitamin C+. It contains iron, potassium and sodium. It is an excellent fruit to quench thirst.

23. KHARMUJ Hindi and Beng., Musk-melon Eng.—Diuretic, refrigerant, tonic, aperient, useful in diseases of the liver.

24. NASPATI Hindi and Bengali, Pears Eng.—Hard of digestion, carminative, appetising, calories 10, vitamins B+, C+. "Pears contain nitric acid, pectose, gums, sugar, albumen, and some valuable salts. Its external skin or rind is laxative, but the inner portion has the property of constipating the bowels."

25. PINEAPPLE, *Anáras* Beng., *Anánás* Hindi.—It contains muriatic acid, a constituent of gastric juice. Appetising, carminative, phlegmatic, antibilious, cooling, hard of digestion, kills intestinal worms, calories 12, vitamin C++.

26. PHALSA Beng. and Hindi.—Ripe fruits are cooling, astringent, nutritious, useful in bilious fever.

27. GOLAPJAM Beng., *Roseberry* Eng., *Phalendra* Sans.—It is sweet, has a very fine flavour, heavy and appetising.

28. ORANGE, *Kamalá Lebu* Beng., *Nárangi* Hindi. —Cooling, easy of digestion, stomachic, refrigerant, appetising, stimulant, tonic. It is valuable for the

citric acid and citrate of potash, albumen, sugar, sodium, iron. They are nutritious and wholesome, and allay thirst and vomiting. The juice is valuable in bilious affections and stops bilious diarrhoea. Calories 12, vitamins A+, B+, C+++. Orange with its rind is made into *morabbá* which is a delicious food. In influenza and plague, if oranges are eaten freely, they will prevent pneumonia and other troubles. It is a good remedy for dyspepsia, asthma, liver troubles, coughs, bronchitis, heart-troubles, typhoid fever, etc.

29. APPLE, *Apel* Beng., *Seo* Hindi.—It contains albumen, gum, sugar, potash, soda, etc. It cures acidity, dyspepsia, colic, diarrhoea, disorders of liver and kidneys. It is very useful in general debility. Cooling, easily digestible, appetising and nutrient. It has calories 15, vitamins B+, C+.

30. RASBHARI Hindi, *Tepári* Beng., Gooseberry Eng.—Excites secretion of saliva. It is a little laxative.

31. BAEL Beng. and Hindi.—The unripe fruit is stomachic and astringent and is used in dysentery and diarrhoea. The pulp of the fruit is boiled and mixed with sugar and taken in the morning in empty stomach in dysentery and diarrhoea. The ripe fruit is aromatic, has a cooling effect if drunk with water, curd and sugar,—this *sharbat* is laxative. Bael is a great remedy in irregularity of bowels, flatulence, habitual constipation. One can take advantage of this useful fruit throughout the year by keeping it after drying or preserving it as *morabbá*. Calories of ripe fruit are 30.

32. LEMON or Lime, *Lebu* Hindi and Beng., Citrus Latin.—It has several species,—(1) *citrus medica,* (lime), *páti lebu* and *kágzi lebu,* (2) *citrus medica*

(lemon) ; (3) sweet lime (*sarbati lemu* Hindi), (4) sweet orange (*kamalá lebu* Beng.)—Lemon-juice is refrigerant and stomachic. Fresh lemon juice allays the thirst in fevers and stops nausea and vomiting in dyspepsia. Common sour lime is a remedy in enlargement of spleen; it should be daily used with common salt in some kinds of indigestion. The juice is digestive and kills intestinal worms, calories 5, vitamins B +, C + + +.

33. AMLA Hindi, *Amalaki* Beng. and Sans.—It pacifies *váyu*, *pitta* and *kapha*. It allays thirst and vomiting. Its *morabbá* is tasteful and good in dyspepsia.

34. KAETHBEL Beng., *Kawit* Hindi, *Kapithwa* Sans., Wood-apple Eng. Unripe fruit is an useful astringent in diarrhoea and dysentery. The ripe fruit increases the appetite, and is generally eaten as *chátny* with sugar or as *sharbat*. It quenches thirst. The syrup is used in salivation, sore throat and in strengthening gums.

35. PAPAYA, or Papaw, *Penpe* Beng., *Papitá* Hindi. —It contains sodium and calcium salts and is useful in dyspepsia, liver and spleen troubles. The fruit, either green or ripe, is cooling, appetiser, carminative, laxative and very useful in piles. Unripe fruits are used as vegetables. It has digestive properties. Calorie 1, vitamins A +, B +, C + + +, D +.

36. PHUTI Beng., *Phut* Hindi, White Melon Eng. —It is heating, laxative, increases *váyu*; good in asthma and cough. When unripe, it is called *Kánkur* in Beng., and is used as a vegetable.

37. GRAPE FRUIT or *Bátábi Lebu* Beng., *Chakotra* Hindi. —It is refrigerant, palatable, digestive, nutritive, cures hiccough. The fruit is very large,

containing sugar and citric acid. It is rich in vitamin C.

38. SANKALU Beng., a tuber, *Sankhálu* Sans.—It is white, sweet, cooling, laxative, diuretic, allays thirst, pacifies *váyu*, increases *kapha*, increases relish for foods.

39. SARBATI *Lemu* or *Mithá Lebu* Hindi.–They are useful in appeasing thirst and vomiting, and as refrigerant in fevers and jaundice. "Sweet lime contains phosphates of calcium, iron, potash and soda. It also contains citric acid and citrate of potash. It is useful even in worst type of typhoid fever, smallpox, dengue, influenza, cholera, constipation, colic and worm troubles."

40. APRICOT, *Jardálu* Hindi, met with in the Himalayas, Deccan and Mysore. It is nutrient and tonic. Dried fruit is used in fevers to allay thirst as refrigerant and laxative. Apricot oil is almost similar to almond oil.

41. PEACH contains iron, gum, sugar, and acids. It is tonic and aperient and is useful in fever and anaemia.

NUTS and DRIED FRUITS

NUTS are dry fruits or seeds having hard shells inclosing kernels; the kernels themselves are also called nuts. "Nuts of all kinds are rich in proteins and most of them are also very rich in fats; their proteins are fairly good, being better than those at the cereal grains and pulses (*dáls*). * *An ounce of nuts contains more protein than an ounce of egg and 5 or 6 times as much fat. Nuts are rich sources of vitamin B, but they contain very little

vitamin A and no vitamin C. They should always be eaten with, and not at the end of a meal and should be well-chewed."—"*Food*", p. 87. Those who have no teeth, and cannot chew well should powder or grind the hard nuts either dry or with water and then eat the powder or pulp.

42. MAHUA Hindi & Beng., Indian Butter Tree Eng., *Madhuka* Sans.—The fruits are sweet, strengthening, cooling, hard of digestion, pacifies *váyu* and *pitta*, thirst, burning sensation. Some people eat *roti* made of wheat flour and *mahua* mixed together. The flowers are also sweet and strengthening.

43. ALMOND, *Bádám* Hindi and Beng.—It contains oil, proteids and phosphorus. Useful in general debility, brain-fag, flatulence, vertigo, headache, neurotic dyspepsia, and torpidity of liver. It is a nervine tonic and demulcent, hard of digestion. Bitter almonds act as poison; they should be avoided. Calories 176, fat 53 p. c., protein 24 p.c., carbohydrate 7.

44. WALNUT, *Akhrot* Hindi and Beng.—It contains phosphorus, phosphates of potash, calcium and magnesium and are suited to brain-workers. Walnut oil is a remedy for eczema and other obstinate skin diseases. Heating, aperient, carminative, calories 209, fat 62 p. c., protein 15 p. c., carbohydrate 7 p. c.

45. FIGS, *Dumur* Beng., *Gullar* Hindi.—Good, sweet, dried figs are indented from Asia-Minor. They are nutritious, cooling, laxative, demulcent, wholesome and easy of digestion. Dried Turkey figs contain carbohydrate (starch, sugar, etc.) 66 p.c. They contain sugar, phosphates, gum, albumen, etc.

46. RAISIN, *Kismis* and *Monakkā* Hindi and Beng., *Drākshā* Sans., Currants Eng.—They are dried grapes. *Kismis* is sweet-sour, and has no seeds; *monakkā* is sweet and has seeds. They have generally the same properties as ripe fresh grapes. *Monakkās* are a little heavy, but *kismis* is easily digestible. They are cooling, diuretic, laxative, nutritive, blood-purifying, demulcent, expectorant, pacify *kapha* and *pitta*, fever, thirst, asthma, and heat, calories 73, vitamins B+. Raisins contain calcium, potassium, magnesium, phosphorus and iron. Black currants contain more of iron than other ones.

47. PISTA Hindi and Beng., Pestachio Eng.—It is a native of Western Asia. Nutritive, heating, aromatic, tonic, difficult to digest.–Its composition is almost identical with that of the groundnut.

48. ALUBOKHARA means *Alū* or Plum of Bokhāra called Cherry Plum in Eng. It grows in the Western temperate Himalayas. It is cooling, and creates taste, astringent, not easily digested, but is digestive, nutrient, increases *kapha* and *pitta*. It is demulcent and a cooling laxative when taken in empty stomach. Useful in bilious states and heat of body; and in cases of torpid and enlarged liver, piles, etc.

49. GROUND-NUT or PEA-NUT, *Mūngphali* Hindi, *Chinā Bādām* Beng.—It is a nutritious, fatty, cheap food. It should be more extensively used by the people. It contains 43 p.c. fat.

50. NUTS of KAJU, *Cachew-nuts*. The nut is kidney-shaped and about 1 in. long. *Kājū* fruit is called *Duk* in Hindi. The nut is called *Hājli-Bādām* in Bengal. The sweet fruits are used by the people of Southern India, for the tree grows

in South India. The kernel is good for weak patients. It contains a pleasant, wholesome oil and is a common article of food in the tropics. Nuts contain soda, iron, and some silica.

Indians sometimes use other dried fruits and nuts, such as *Chilgojá*, *Chironji*, Chestnut, etc. Their properties are very little known to the Indians.

Value of Fruits

"Fruits have several healing and vitalising properties and many human ills can be mitigated by a discriminate use of fruits. Fresh fruits have a cleansing effect on the teeth and gums by reasons of their oxygen content. The fruit gardens are the factories of nature in which drugs and vitamins are manufactured under the action of tropical sun for the good of men and beasts. The acids of the fruit help digestion largely. Brain demands nutriment as the tissues of the body. Every exertion of the mind results in the wastage or decomposition of the mysterious grey matter forming the organ of the brain. It has definitely been established beyond doubt that the greater the mental exertion is, the greater amount of phosphorus is used and a man of good intellect comparatively possesses a greater quantity of phosphorus in his brain. Hence the value of phosphorus-containing fruits for brain-workers. Fruits have alkaline mineral salts and feeble acids and the potassium and calcium salts. The tartaric and malic acids in fruits are quickly burnt up and form alkaline carbonates. An ideal fruitarian meal would consist of a mixture of almonds, and Brazil nuts with grapes, apples and oranges."

Preserved Fruits

They are far inferior to fresh fruits. But they are serviceable to some extent where fresh fruits are not available.

OILY SEEDS AND OILS

1. INDIAN MUSTARD, *Sarsap* Sans., *Sarson* Hindi, *Sarisá* Beng.—White mustard is better than red one. Poultice, plaster and liniment are made from pounded seeds. The oil from the white mustard is said to be a good edible oil. Red species is extensively cultivated throughout tropical India. The *oil* is used for cooking and for smearing over the body. The oil keeps the skin soft, destroys bacteria and has antiseptic properties. When the body rubbed over with the oil is exposed to the sun, vitamin "D" is formed. The oil is appetiser, light, pungent, heating, increases *rákta-pitta*. It cures phlegm, piles, worms, etc. It has vitamins A+, B++. Calories of it are 252. Black mustard gives 25 p. c. oil, white mustard 20 to 25 p.c. oil.

2. POPPY SEEDS, *Khaskhas ká bij* Hindi, *Postadáná* Beng.—Hard of digestion, nutritious, carminative and phlegmatic. They are useful in diarrhoea and dysentery. They have no intoxicating properties. They are innocuous, and are used as an article of food. The *Oil* is used for culinary purposes. It is mixed with *ghee* for adulteration. The oil-cake is said to be a wholesome food. Medicinally the oil is used like olive oil in doses of ½ to 1 dram. Poppy seeds are used as syrup in cough and asthma.

3. COCOANUT OIL, *Náriel ká Tel* or *Khoprá ká Tel* Hindi, *Nárikel Tel* Beng., *Nárikel Taila* Sans.—

The kernel contains 30 to 70 p.c. oil. The oil is used for cooking and rubbing over the body and hair. Ghee is easily adulterated with it. The oil is hard of digestion, but is cooling and nutritious. The *Oil* prepared from fresh pulp is used as a substitute for Cod-liver Oil in American hospitals in wasting and pulmonary diseases of children; the dose is from 20 to 30 drops, gradually increasing to 1dr. thrice daily; the only drawback is its indigestibility. It has vitamin A+, calories 252 (as other oils have). Cocoanuts give 35 p.c. oil.

4. TIL seeds and *Til* Oil, or Sesame Oil. *Til* Hindi and Beng., *Til* or *Snehaphal* Sans.—There are 3 kinds, black, white and red. The black variety is the most common and yields the best quality of oil. The seeds are laxative, emollient, demulcent, diuretic, nourishing, and lactagogue (increases milk), useful in piles. *Tils* with sugar are used in making confectionery. They yield 51 p.c. oil. *Til oil* is tasteless and odourless; it does not become thick or rancid. Therefore it may be employed medicinally for all purposes to which olive oil is applied. The oil is largely used for culinary purposes, for anointing body, etc. Internally the oil is used in gonorrhoea. It is used as demulcent in dysentery in combination with other medicines of their class.

5. CASTOR OIL, *Endi* ká *tel* Hindi, *Rerhir tel* Beng., *Eranda-taila* Sans.—It is heavy to digest, but has digestive power, is heating, demulcent, nutritious; laxative, cures constipation, dropsy, pain in the stomach;—dose 1 to 8 drams. Pure, clear, odourless, colourless oil is drawn from good selected seeds by expression without heating the

husked seeds. Such oil is used as a laxative and for medicinal purposes. It is administered in inflammatory conditions of the bowels, in simple diarrhoea. The usual dose for a child is about one teaspoonful, gradually increased according to age to 2 or 3 table-spoonfuls, which is the full dose for an adult. It is best given floating on warm milk, or in dry-ginger-water or *ájowán* water. In painful affections of the rectum, in piles and to prevent the patient straining at stool, castor-oil in small doses is often of great service to soften the faeces and lubricate the passage. It is a mild purgative operating within 4 to 6 hours. The oil must be warmed in cold weather before administration. Food retards its action. It is an excellent remedy for acute dysentery when given with opium, at the very onset (oil 2 to 4 drs. and tincture opii to 10 to 20 minims). As an enema it has been given with success in impaction of the large intestine and rectum.

6. ALMOND OIL, *Bádám ḳá Tel* Hindi, *Bádámer Tel* Beng.—Oil from sweet almond is a soothing application for irritable skin-diseases. The oil is a mild purgative in 2 to 4 drams dose. An enema of 1 to 3 pints of the oil has been found effective in impaction of faeces and obstruction of bowels. It is pleasanter than olive oil. Almonds give 53 p.c. oil. It cools inflammation, specially of the lungs. For earache, cramps, or wind in the ear, pour 6 or 8 drops into the suffering ear. Olive is a substitute for it.

7. GROUNDNUT or *Earthnut* or *Peanut Oil, Mungphali ḳá Tel* Hindi, *Chiner bádámer Tel* Beng.—Internally it has a gentle aperient and emollient action. Ghee is generally adulterated

with this oil. The oil is a good substitute for olive or almond oil for medicinal purposes. The groundnut-meal as food is very nutritious, containing 32 p.c. nitrogenous compounds, 38 p.c. starch and sugar, and 12 p.c. fatty matter. In the preparation of groundnut-*butter*, the shelled nuts are first roasted moderately (not scorched) so as to remove their thin brown coverings and the germs, after which they are ground to a pulp, which is then bottled. Nut-butter will mix with water and is used as a substitute for cream.

8. OLIVE OIL, *Jalpái ká Tel* Beng.—Externally used, it makes the skin soft, smooth and supple. It is an excellent emollient in dry skin diseases. It checks debilitating sweating when rubbed over the body. Internally, it is a nutrient and a food in wasting diseases. In large doses (1 to 2 oz.) it is a mild laxative, producing painless soft stools, and is therefore of great value in inflamed and ulcerated piles, rectal ulcers, anal fissures and constipation. It has been strongly recommended as a solvent for gall-stones. It acts also as a laxative when given as an enema (4 oz. to ½ pint of starch mucilage) in faecal impaction and intestinal obstruction. According to Ayurveda if used with other foods the oil is digestive, nutritious, strengthening, laxative, and increases relish for food. It is good in worms, leprosy and pimples.

9. LINSEED OIL, *Álsi ká Tel* Hindi, *Tisi* or *Mashiná ká Tel.* Beng.—Contused linseed in the form of warm poultice is used to disperse threatening abscesses, boils, carbuncles, or local inflammations. Warm poultice helps suppuration. Hot linseed meal poultice is an excellent, mild, conti-

nuous counter-irritant for deep-seated inflammations, such as, pneumonia, bronchitis, bronchopneumonia, pleuritis, etc. The oil makes a good emollient application to burns and scalds. The oil can also be used as an enema (1 lb.) in impacted condition of the rectum and lower colon. Internally, infusion of linseed, especially when combined with lemon, is a reputed domestic demulcent drink in throat cough. It is prescribed in spasmodic affections of the bowels. In case of piles it is given in doses of 1 to 2 oz. morning and evening. According to Ayurveda, the oil is heating, lubricant, laxative, appetiser, strengthening, pacifies the 3 *doshas*, useful in application over skin-diseases, and in giving injections. Linseed gives 28 p.c. oil.

IV.—MILK and ITS PRODUCTS

Milk—(*Dugdha* or *Kshira* Sanskrit, *Lactus* Latin, *Dudha* Hindi and Bengali)—contains all the elements necessary for the growth and nutrition of bones, nerves, muscles, and other tissues. Cow's milk contains on an average albuminoids (casein) 4 p.c., fats (butter) 4 p.c., sugar (milk-sugar) 5 p.c., various salts etc. 1 p. c., and water 86 p. c.; specific gravity 1030. Cow's milk has calories 18. Buffalo's milk is richer than cow's milk and yields more butter, calories 30. Human milk contains all the elements necessary for the tender body and nothing more nor less. Not a single specimen of artificial food is a substitute for human milk. Vitamins of cow's milk are A+ + +, B+ +, C+, D+; of human milk A+ to+ +, B+, C+; of buffalo's milk, goat's milk or sheep's milk A+ + +, B+, C+, D+. Next to human milk

comes the ass's milk, next comes the cow's milk. Pure milk containing 86 or 87 p. c. of water as it comes from the cow, can remain pure for some hours; but when water is mixed with it, the milk will be deteriorated in less time. If the milk be just boiled after mixing it with water, there will not be such deterioration.

According to Ayurveda, milk is nourishing, strengthening, stomachic, producing semen, increases intellectual power and memory, removes fatigue, produces sleep, and pacifies the 3 *doshas*. Milk of cows or buffaloes after calving should be avoided for 15 days. The milk of other animals after the delivery of their calves should be avoided for 7 days or more, because such milk is unhealthy for human consumption. The lukewarm milk of cows, or buffaloes, or goats, just after milching, is far better than cold unboiled milk or warm or cold boiled milk. Milk is a suitable drink for the young and old. Milk should not be used during the incipient stage of fever, low fever, in diarrhoea, and some other diseases. Milk should not be used with fish, flesh, salt, radish-leaves, etc. For those who cannot digest pure milk unmixed with water, the milk should be diluted with requisite quantity of water and then boiled. Milk thickened by boiling is heavy of digestion. It is quite unfit for weak stomach. Boiled milk is generally better than unboiled milk. Whether the milk be warm or cold, drink it slowly by sipping or by the use of a spoon or straw, so that it is mixed with saliva, and thus the process of digestion is commenced in the mouth.

According to the advice of the doctors unboiled milk of cow or buffalo is better than

boiled milk, because by boiling milk its vitamins are lost. On the other hand, they advise that as a large number of cows are suffering from tuberculosis and other diseases, and the milk-vendors contaminate the milk with unclean water, it is safe to boil the milk as soon as possible after milching. Milk should not be kept in an unboiled state for more than 3 hours. Unboiled milk kept for more than 3 hours in summer and 12 hours in winter is harmful; therefore avoid such milk. It is better to reboil it to make it drinkable. Most medical authorities agree that boiled or twice-boiled milk has less nutritive value than that which is fresh. A discrimination needs to be made in this matter. Instead of boiling milk over naked fire, heat the milk in a water-bath not more than 160 deg. F for 20 minutes or so. Milk boiled in the vapour of a modern "cooker" is good. Milk of cows affected with foot-and-mouth disease should never be consumed. *Sterilization* is heating the milk to 230 deg. F for half an hour in air-tight pot and then allowing it to cool down gradually in air. Milk is *pasteurized* by heating the fresh milk to 145 deg. F for half an hour and then immediately keeping it immersed in cold water at 40 deg. F temperature. The latter process is better than the former. Pasteurized milk is absolutely safe and conserves the vitamins, which boiling destroys.

Purity of milk is most important. All sorts of care and precaution should be taken to keep the milk pure. The cow, goat or buffalo should be healthy; the cowshed should be properly built and cleaned; the udder and teats should be well-washed with some mild disinfectant before

milking; the milk should be kept in airy cool place free from dirt or smoke, in clean vessels or bottles in such a manner that flies, spiders and other insects may not have access to the milk. Milk, not kept in a clean manner, is liable to be contaminated and specific organisms often gain access to the milk from dirty vessels, unclean hands or dirty water added to it. Cholera, typhoid fever, diarrhoea, dysentery and such other diseases are disseminated through impure or contaminated milk. Decomposed milk gives rise to nausea, vomiting, diarrhoea, cramps and collapse. If the milk is discoloured, sour, bad-smelling, curd-like, saltish, you should avoid it. Glass, enamelled or porcelain are better than earthen or metallic vessels for the preservation of milk. Milk should always be drunk slowly by sipping it.

Some sorts of Adulterations in Cow-milk are :—skimmed milk, arrowroot, *sati*-food powder, powder of dried *singhárá* (Hindi) or *pánifal* (Beng.), sugar, *suji*, buffalo-milk, ordinary or polluted water, etc.

Health and Happiness (February 1936) a monthly medical journal of Calcutta, has given a summary of investigations of the United States Public Health Service;—"Milk is an excellent food because, (a) it is a natural food, (b) it is a cheap source of energy, (c) it is a good muscle-builder, (d) it is a good tooth and bone builder, (e) it is a highly concentrated food, (f) it is an excellent source of vitamins A and G; (g) it is highly digestible."

Buffalo's milk is more thick, heavy, cooling, fatty, sweet, appetiser, producing semen, than cow's milk. The percentage of fat in buffalo-milk is 9, and in cow-milk 5.

Goat's milk is useful in phthisis, bile (*pitta*), cough, chronic diarrhoea, and vomiting in children.

Sheep's milk is alleviative of phlegm (*kápha*) and bile (*pitta*) and beneficial in obesity, flatulence and gonorrhoea.

Ass's milk is useful in general debility, high-coloured and scanty urine, etc. It is extensively used as a remedy against cough and liver-complaints especially amongst children and old people.

Human milk is recommended to grown-up people suffering from chronic asthma and consumption.

Camel's milk is useful in dropsy, asthma and general scrofulous conditions; in inflammations, cancers, piles, intestinal worms, skin lesions and poisonings.

Ayurveda has described the uses of Ewe's milk, Mare's milk, Elephant's milk, etc. In Ayurveda it is mentioned that properties of milk of cow vary according to the colour of its skin. For example, milk of black cows is very wholesome and good in '*váyu*' diseases.

Products of Milk

(*a*) *Curd* or *Curdled Milk*; *Dahi* Hindi and Bengali, *Dadhi* Sanskrit. It is prepared by adding some acid juice or powder, generally lime-juice, or a little curd as a ferment to lukewarm milk previously boiled. In course of about 12 hours the

milk is changed into curd, which is sour, coagulated thickened milk. It contains a large proportion of nutritious substance. Curd is a useful food and is nutritive as milk. On account of its acidity it helps digestion; and it kills the bacteria found in milk. To some persons in certain states of health, curd is more suitable than milk. In certain diseases curd is prescribed. Those who find milk constipative, can use curd which is not so. Composition of curd is water 88 p.c., protein 4·5 p.c., fat 3·5 p.c., carbohydrate 2·5 p.c., salts ·5 p.c., Vitamins A++, B+, C+, calories 18. According to *Ayurveda* curd from cow's milk is best; it is strengthening, appetiser, cooling, nutritive, pacifier of *váyu.* Curd increases phlegm, *rakta-pitta,* dropsy and fat. Curd is prepared in 5 different ways.

(*b*) *Butter.*—Hand-made butter is produced by churning with a hand-churner milk or curd;—the remnant milk or curd is called *Butter-milk, Whey* or *Ghol.* In the present days two kinds of Butter are produced...Their constituents and properties are different. The 1st kind is made by churning by hand-churner either milk or *dahi*;—the remnant is called *Máttha* or Whey. The 2nd kind is produced from Cream by centrifugal machine. This Cream has been previously churned out by a Machine-churner from milk. The remnant of the Cream is a white-coloured watery substance, called Butter-milk, quite different from hand-made *whey.*

(c) *Whey* or *Ghol.*—This sour milk-like thing is easily digested by those who cannot digest the fatty portion (butter) of milk. *Sarbat of*

Ghol is prepared by mixing sugar with it. It is a delicious drink. *Whey* is said to have similar properties as those of curd. In particular it is said to favour the circulation of the animal fluids and is therefore useful in constipation.

(*d*) *Cream*.—At the present time machines are used for first extracting Cream from raw milk by centrifugal force; and secondly for extracting *butter* from the cream. The remnant of the cream, after extracting the *butter*, is called *Butter-milk*.

(*e*) *Skimmed Milk* and *Butter-Milk*.–*Skimmed Milk*, the remnant of the milk after butter is extracted, and *Butter-milk*, remnant of the cream after butter is extracted, are healthy drinks. Skimmed-milk is cooling, palatable, astringent, useful in diarrhoea, dysentery and piles. Skimmed milk has the above properties, but is not so easily digested as butter-milk. Butter from cow's milk is tonic, cardiac, stimulant, invigorating, and stomachic. Butter from buffalo-milk is sweetish, astringent, refrigerant, demulcent, generative of semen, alleviative of wind and bile. Butter has 13 p.c. water, 1 p.c. protein, 83 p.c. fat, 1 p.c. salts, and 1 p.c. ash. Vitamins of cream A + + +, B+ +, C+ ; of butter A+ + +. Skimmed milk has vitamins A+, B+, C+. Fresh butter is a very nice fatty food. It can be taken with sugar or honey. Stale butter should not be used. Butter-milk is rich in nitrogen, and with other food is a valuable article of diet.

(*f*) *Ghee* or Clarified Butter is produced by heating butter. By this heating process the water remaining in the butter is evaporated ; and

the impurities which are deposited at the bottom are thrown away. Of all the fatty foods *ghee* is highly esteemed by the Hindus. *Ghee* from cow's milk is better in taste and flavour than the *ghee* derived from the buffalo-milk,—the former is more easily digested. It is also called *áyuh* (life), *amrita* (nectar) and *pabitra* (pure) in Sanskrit. Generally fresh *ghee* is tonic and strength-giving; it gives protection from cold; it increases beauty, youthfulness, intellectual power and memory. It is useful in weakness, fatigue, jaundice and consumption. It should not be used in fever, constipation, cholera, want of desire for food and indigestion. *Puráná Ghrita* or *old Ghee* of 10 years or more has a strong pungent odour and reddish-brown colour. It is very valuable in external application. *Ghee* has vitamin A + + +. It is difficult to get pure *ghee* in the markets of India. *Ghee* is adulterated with vegetable oils of cocoanut, groundnut, safflower, cotton seeds, poppy-seeds, *til*, etc. Even castor-oil is mixed. Starches such as rice, plantains, potatoes, etc., are resorted to in order to thicken oily compositions. Fats from carcasses of diseased animals such as, snake, sheep, pigs, etc., are used. Pure oil is better than such adulterated *ghee*.

(*g*) *Chháná* (Bengali) or Coagulated Milk or Inspissated Milk is produced by putting a few drops of lemon juice or any acid or water of previously made *Chháná*, into boiling milk. By this means the milk is split and the thickened portion and watery portion separated. The thickened portion is then poured into over a piece of cloth and pressed and thus *Chháná* is produced. The watery

portion is prescribed for those who cannot digest milk or its other products. *Chhánà* is a solid nitrogenous nutritious food. It is as nutritious as flesh. Sweetmeats are prepared from *Chhánà*. It contains 59 p.c. water, 12·5 p.c. protein, 17 p.c. fat, 3 p.c. carbohydrate, 1·5 p.c. salts. It has vitamins A + +, B+ +.

(g 1) *Chhánà ká Páni*, (*i.e.*, *Chhánár Jal*) is the water-content of milk after casein is precipitated. Some people extract *ghee* (3 p.c.) out of it. This water contains 4 parts sugar of milk, 3 parts fat, various salts 1 part, nitrogenous elements 1 or 2 parts, water 80 parts. It contains a large percentage of calcium phosphate, an important salt required for the formation of bones and also for proper coagulity of the blood. It is an agreeable, digestive and cooling drink. It is acid and astringent and according to Ayurveda, relieves *váyu*, produces marrow, vitality, strength, and blood, aggravates *pitta* and *kapha*, it is appetiser, and in particular, it is said to favour the circulation of the animal fluids, and is, therefore, useful in constipation, and beneficial in spleen, piles, diarrhoea, cholera, colic and typhoid fever. Continuous use of this fluid, containing lactic acid, helps to bring your intestines in proper order. It is highly useful in phthisis, dysentery and chronic catarrh. For a convalescent, who cannot digest milk, or milk does not suit him, this kind of whey is nutritious and suitable. It can be prepared by putting a few drops of lemon juice or tamarind water in boiling milk.—(M.M. Varman, in the *Calcutta Municipal Gazette* of 24-3-34.)

(*h*) *Cheese* is chiefly the curd of milk, containing also a proportion of fat, entangled in the curd. Fresh milk is warmed to 80 deg. F and then rennet, made from calf's stomach, is added to it. It is allowed to stand for an hour, by which time the thick curd is formed. The curd is then cut up into small pieces and the whey poured off. The curd is then removed, put into a vat, and placed under a press to expel the whey. The curd is thereafter broken up again and mixed with salt, at 56 to 2 proportion. The cheese is then daily turned, greased and polished in a room, kept at a temperature of 75 deg. F; after three or four months it is ready for use. Acid, vinegar and other agents for curdling may be used instead of *rennet*. Ten pounds of milk are required to make one pound of whole-milk cheese. Composition of hard cheese of America is about 30 p.c. water, 34 p.c. nitrogenous substances, 33 p.c. fat, 3 p.c. saline; calories 111 per oz., Vitamin A++. On account of the presence of rennet, of tedious process of preparation, its high price, and strange taste, Indians seldom use cheese. Cheese can also be prepared without rennet, by adding some vegetable thing.

(*i*) *Evaporated or Condensed or Concentrated Milk.*—*Condensed Milk* is prepared by evaporating the milk in vacuum pan and then to heat to the boiling point, cane-sugar being added. The milk is then preserved in tightly-soldered tins, so that air has no access. In other cases milk is concentrated, no cane-sugar being added. In sweetened condensed milk 40 p. c. sugar is added, in addition to the existing milk-sugar 10·8

p. c.; it contains water 24 p. c, nitrogenous 13 p. c., butter 8·6 p. c., saline 2 p. c. This exceedingly sweetened milk is unpleasant to many people, though the presence of sugar enables the milk to keep for a considerable time after the tin has been opened. Unsweetened kind keeps for a much shorter time after the tin has been opened; and it contains about 50 p. c. of the actual solids of milk, curd, butter, milk-sugar and salts,—much greater percentage than sweetened condensed milk. Vitamins of condensed milk are A + + +, B + +, C +, D + +. *Once-boiled milk* has such vitamins, but *unboiled* milk has vitamins A + + +, B + +, C + +, D + +. Fresh milk is far better than tinned condensed milk preserved for a long time. The condensed milk might be used when and where no fresh milk is available.

(*j*) *Milk Powder or Dried Milk*—also called *Desiccated Milk* or *Lactogen*—is a fine powder of milk from which all the water is drawn off. The drying is done by throwing milk in fine spray over heated roller so instantaneously and carefully that the vital properties of the milk remain absolutely intact, though the milk is left as a fine powder. The advantage of the powder is that it can be easily carried from place to place. When there is a necessity of drinking milk, in a place where no fresh milk can be had, the powder can be mixed in cold or hot water, and then taken as food.

(*k*) *Lactose or Milk Sugar* is a crystallised, greyish white, odourless, faintly sweet, hard gritty when chewed, obtained from the whey of milk. Homeopathic pilules, globules and triturations are made of this milk-sugar. It is soluble in cold

water 7 times of lactose, and in boiling water of the same quantity as lactose. Milk-sugar greatly increases the flow of urine and is therefore given in cardiac dropsy and albuminuria. Because it does not ferment in the stomach, it is the best sweetening agent in infantile dyspepsia and irritable conditions of the stomach.

(*l*) *Sugared Thickened Milk* (*Rabrih*) is prepared according to Indian method by boiling milk continually till it becomes thickened. Sugar is put in the boiling milk. It is more tasteful than sweetened condensed milk. It is difficult of digestion. When rice, *suji*, arrowroot, barley, sago, tapioca, *chiráh, sati* powder, etc., are boiled along with pure unwatered milk and sugar, the milk becomes partly thickened. This kind of nutritious milk food is suitable to certain stomach, which cannot digest milk alone. Such food can also be prepared without sugar.

(*m*) *Bálái* Hindi, *Málái* Bengali is the fatty layer of milk formed on the surface of the milk kept in a vessel, in which the milk has been previously boiled. It has a delicious flavour, and is as nutritious as butter.

(*n*) *Khoyá* is made by continually boiling milk until it becomes sufficiently hard. Sweetmeats are made from *khoyá*, which is not deteriorated in a week or so. One *seer* of pure buffalo milk yields 4 *chhatáks* of *khoyá*, and one seer of cow's milk, 3 *chhatáks*. *Rabrih* is prepared similarly by mixing sugar with milk. These are heavy foods. In summer *khoyá* is deteriorated in two or three days, and in winter in seven or eight days. Varieties of sweet-meats are made with it.

(o) In the European countries there are some other preparations of milk, such as *Artificial Human Milk, Plasmon, Sanatogen,* etc. The processes of such preparations are costly and difficult. These preparations are generally used by such diseased persons, as can afford to pay high prices. The artificial preparations are wanting in vitamins.

Percentage Composition of

	Cream	Skim-milk	Butter-milk
Water	55	89	91
Nitrogenous	6	4	4
Butter or fat	36	0·4	1·25
Sugar	2·5	5·5	3·7
Saline	0·2	0·8	0·6

Proteins, Fats, and Carbohydrates in gramme per ounce, Calorie-value and Vitamin-contents of Milk and its Products.

	Proteins.	Fats.	Carbohy-drates.	Calories per ounce	Vitamins. A	B	C	D
Cow's milk	1	1	1·3	18	+++	++	+	+
Human milk	·4	1·5	·7	18	+ to ++	+	+	
Cream	·7	5	1	55	+++	+		
Butter-milk	·8	·1	1·3	10	+	+	+	
Skimmed milk	1	·1	1·5	10	+	+	+	
Dadhi (Curd)	1·5	1	·8	18	++	+	+	
Goat's milk	1·2	1	1	20	+++	+	+	+
Buffalo's milk	1·3	2	1	30	+++	+	+	+
Butter & Ghee		23		208	+++			+

One ounce = 28·3 grammes; one gramme = 15·5 grains.

Cow's milk yields 9 p. c. cream, 91 p. c. skimmed milk, 7 p. c. butter (percentage varies according to water added during churning butter-milk), 6·5 p. c. ghee, 18 p. c. *chhánà* (coagulated milk), 10 p. c. cheese, 50 p. c. condensed milk, 11 p. c. dried milk, 14 p. c. lactose or milk-sugar, 16 to 18 p. c. *ḳhoyà*.

Buffalo's milk yields 12 p. c. cream, 88 p. c. skimmed-milk, 10 to 10·5 p. c. butter (percentage varies according to water added during churning butter-milk), 9 to 9·5 p. c. ghee, 25 p. c. *chhánà*, 12 p. c. cheese, 55 p. c. condensed milk, 13 p. c. dried milk, 17 p. c. milk-sugar, 25 p. c. *ḳhoyá*.

The above percentages vary according to the nature of milk and the method of preparation.

V.—ARTIFICIAL FOODS, MISCELLANEOUS FOODS, INVALID FOODS

(1) *Artificial Foods* are generally far inferior to natural foods. Tinned and patented foods, stocked in the shops of India from foreign countries are deficient in vitamins, they get deteriorated in course of time, and are consequently worse than fresh Indian foods. Foreign commercial biscuits, cakes, and similar baked articles, and sweet-meats such as chocolate, toffee, etc. are not good. They should be avoided by the Indians.

(2) *Miscellaneous Foods.* Food prepared by the combination of several foods; rich foods, cooked with large quantities of *ghee*, fat, *bádám*, *ḳismis*,

spices, etc., often produce heaviness, indigestion, constipation or diarrhoea, and are precursors of other diseases. We should try to avoid them. Some of the artificial foods are injurious to health, —such as, salted fish or meat, dried fish, pungent *chatneys*, fried stale meats, foods prepared with adulterated oil or ghee, etc.

(3) *Invalid Foods.*—We should prepare invalid foods according to the directions of Vaidyas and sometimes under the directions of Doctors. You will find the methods of preparing *Regimen for the Sick* in pages 304 to 314 in my book *Indigestion*, Rs. 2. I do not find space in this book to reprint the pages.

Miscellaneous Foods

Beverages

1. Juice of the Date-tree is cooling, palatable, digestive, nutritious and diuretic.

2. Juice of the Palmyra tree, *tárh ká ras* if unfermented is cooling and diuretic. But the fermented juice called *tárhi* is intoxicating, cooling and diuretic.

3. SARBAT of sugar or *misri* with or without lemon-juice. It is a refreshing drink, especially in summer. It has a cooling effect on the stomach. It is diuretic. People mix the juices of mango, *ánánás*, ripe *bael*, *phálsá*, chips of *tarbuz*, curd, *butter-water*, etc. with *sarbat* of sugar and drink it.

4. ACIDULOUS DRINKS.—Vegetable acids, such as citric acid (derived from lemon, orange, lime, etc.), tartaric acid (of grapes, tamarinds, pine-apples and mulberries), malic acid (of apples, pears, plums, tomatoes, etc.) are largely used as condiments and also as cooling drinks to allay thirst.

5. TEA AND COFFEE.—Some 60 years ago the Indians of the plains seldom used tea. But now tea is widely used by the people of all Provinces. A large number of persons have become slaves to tea-drinking. It is a matter of great regret that the poor people are spending their hard-earned money on tea. Habitual drinking of tea is harmful to the human system. There is no food-value in these drinks; they are mere stimulants. Their occasional use in severely cold days is not bad. If taken regularly or in excess they induce indigestion, loss of appetite and constipation. Coffee stimulates the nervous system, causing wakefulness and increased brain-action. By drinking tea or coffee we simply whip our tired brain and muscles into activity. This is injurious for our system, because we go against nature by not taking rest when we are fatigued.

6. COCOA is the roasted seeds of *Theobroma Cocoa*, growing chiefly in the West Indies. It contains some starch, sugar, fatty food and carbohydrates; so it possesses some nutritive value.

7. AERATED WATERS.—The so-called soda water really contains no soda at all, but is merely an ordinary water highly aerated and charged with carbon dioxide. Actual *soda water* contains 30 grains of bicarbonate of soda to every pint of water. *Lemonade* is simply aerated water passed into a bottle, into which there has been previously put a small quantity of syrup, flavoured with lemon. Similarly *gingerade*, *orangeade*, etc. are flavoured with extracts of ginger, orange, etc. The escape of the gas produces a sharpish, pleasant taste, and has a gentle stimulating action on the stomach, while the gas itself is somewhat

soothing in irritable stomach. Soda-water is a remedy for stomach cough and acid dyspepsia. Lemonade allays thirst in fevers, checks nausea and vomiting. Gingerade is aromatic, stimulant, stomachic and carminative. Habitual use of these waters is harmful : occasional use to serve special purposes is good.

8. MINERAL WATERS.—Mineral Springs and Wells are employed for bathing as well as drinking purposes. There are several mineral springs in India; but they are not much utilized like those of Europe. Mineral waters are classified into (1) Simple thermal waters, (2) Common salt waters, (3) Sulphated waters, (4) Simple alkaline waters, (5) Sulphur waters, (6) Iron chalbeate waters, (7) Iodine, Arsenical, and such kinds of waters. Different kinds of waters have different effects on the human system.

9. COCOANUT WATER and Milk of the young fruit is cooling, refreshing, light, stimulant, useful in thirst, fever, in diseases of the bile and blood and in urinary disorders. Water of the ripe fruit is hard of digestion, palatable, nutritious, digestive and laxative. The *milk of the fresh kernel* is useful in debility, incipient phthisis, in doses of 4 to 8 oz. thrice daily; in large doses it is aperient. The *milk of the green fruit* is a cooling refrigerant drink, useful in allaying urinary irritation. It allays vomiting in bilious fevers.

10. WHEY. This whey is not ordinary *Ghol* produced by mixing water with *Dahi* ; but it is the white-coloured water like Butter-milk left after the extraction of butter from cream which has been previously extracted from milk by machine-churner by means of centrifugal machine.

The whey has a slight opening effect on the bowels, but is also apt to cause dyspepsia and catarrh of the bowels. Consumptive patients and patients with much cough and irritation of the wind-pipe are treated with whey. The whey is being sipped alone at a temperature of 105 deg. F. Daily 1 to 4 pints are consumed. It is milk deprived of its casein or curd, and most of its fat or butter. It contains a small quantity of albuminous material, a little fat, the sugar of milk, chlorides, sulphates and phosphates. The method of Whey-Cure is adopted in many (about 20) Health-Resorts of Europe.

11. GRAPE JUICE.—The large percentage of sugar contained in grapes gives them a pre-eminence as regards nutritive quality above every other fruit of the berry kind. In the inflammatory form of dyspepsia, and in pulmonary affections, ripe grapes are eaten in considerable quantities in Europe. The juice acts both upon the bowels and kidneys, gently stimulating the action of both, especially if taken in the morning in an empty stomach. Several Health Resorts of Europe have resort to "Grape Cure". There from 1 to 8 pounds are consumed throughout the day. Grapes have vitamins B++, C++.

12. SUGARCANE JUICE is a nutritious and cheap drink. It contains about 15 p.c. of natural sugar and vitamins B and C. It is specially rich in organic salts of calcium, iron, manganese, etc., which are rather sparse in other foods. No other drink except fruit-juice is so rich in them. It can be recommended by doctors for patients suffering from anaemia and jaundice owing to its

medical properties. The flavour of the juice can be greatly improved by the addition of a small quantity of the juices of lemon and raw ginger. Poor people will find treacle or molasses (*gurh*) not only cheap sweetening agents, but more useful than sugar, which has no salts or vitamins. (Approved by Dr. McCarrison).

VI.—ANIMAL FOODS

Disadvantages of Animal Foods

1. In flesh-foods the acid waste products are far greater in proportion to the amount of protein actually supplied to the cell than is the case with either milk, *chháná* or eggs.

2. Only raw uncooked flesh have mineral salts. But meat, after it has been cooked and the blood and bones removed is sadly lacking in those mineral elements, which are retained in fullest abundance in fresh milk, *chháná* and eggs.

3. When an animal is killed, its own metabolic processes are violently cut short, so that the waste products are locked up and retained in the system, and are therefore retained by the consumer. The liver, pancreas or sweet-bread and the kidneys of animals, which are imagined as dainty delicacies are full of animal poisons.

4. Stale meat, salted meat, dried meat are abominations. Extracts of meat are equivalent to the *urine* of the animals. Flesh-eating in tropical regions is likely to produce tropical diseases.

5. When fish, flesh or poultry is rotten, a kind of poison called Ptomaine or parasites are pro-

duced therein. Tinned flesh or fish is far inferior to fresh fish or flesh, and sometimes is poisonous. As animals are seldom examined before being killed, the poison is not detected.

6. Flesh has generally less vitamins than several vegetable foods.

7. Meat is very deficient in phosphorus and lime.

8. Flesh excites sexual passion.

9. It increases desire for alcoholic drinks in the drinkers.

10. Meat generally deadens finer sensibility.

Some Properties of Animal Foods

According to Ayurveda the flesh of all animals is generally nutritive. The flesh of birds is lighter and is more easily digested than that of other animals. Egg is a nice substitute for meat. They contain a good supply of lime, sulphur, iron, phosphorus and other mineral salts. Half-boiled eggs are better digested than full-boiled eggs.

Fishes are generally nutritious food. Big fishes are not easily digested and are constipative. Little fishes are easy of digestion, cooling, stomachic and pacify *váyu*. Eggs of fishes are cooling and nutritious. Fish is generally rich in calcium (lime), which is very useful to our system. On account of the presence of phosphoric salts, fish is fit for those who greatly exercise their brain. On pages 1129 to 1132 of "*Indian Materia Medica*" the properties of some edible fishes are cited. In that book you find the effects of flesh of several animals on the human system.

VII.—BAKED FOODS, SWEETMEATS, CONFECTIONS

Baked biscuits, crackers, cakes, etc., made from white flour and indented from foreign countries, are not generally nutritious and health-giving articles; they should be avoided as much as possible. Freshly baked breads (*rotis*) or fried *puris* made of wholemeal flours are nutritious foods.

Sweet-meats and Confections made in India are of hundreds of kinds. As the famous doctors of the present day have condemned refined sugar, the sweet-meats generally prepared from refined sugar can never be healthy foods. Moreover, on account of fatty substance being present in the sweet-meats, they are rich foods, not easily digestible. Loaf-sugar is undesirable food on account of its being a concentrated food and productive of several diseases. Therefore all sweet-meats which contain a large percentage of sugar, should be discarded; and substituted by sweet fresh fruits, dried oily fruits, honey, milk, butter, ghee, sugar-canes, juices from date-palms, etc. Children should sparingly use sweet-meats, but they should be feeded with sweet fruits and dried oily fruits which do not contain more than 8 to 16 per cent of sugar. Sweet-meats cooked with or mixed with *gurh* i.e. brown sugar are not so much objectionable. School students should be given such sweet-meats at midday tiffins. Fried rice or paddy mixed with *gurh* are cheap, nutritive and easily digestible foods for the children, as well as

grown up students. White sugar so universally used in jams, preserves, cakes, pastries and confectionery, has had all its own invaluable mineral salts removed from it during the refining process.

The condiments, such as sauces, pickles (*chatneys*), mustard, vinegar, pepper, common salt, etc. cause direct harm to the human system. Our body wants such salts as sodium, calcium, potassium, magnesium, etc. They are present in all raw, uncooked foods, vegetables and fruits; but are removed from foods by refining, boiling and stewing.

In order to ensure the health and welfare of future men and women, and specially the student community of India, all confectionery articles should be restricted; and instead of them, shops or hotels should be established in which plainest nutritious foods, cooked or prepared on hygienic principles, are available. All boys and girls should daily take some fruits and vegetables in requisite quantities. They should also be given fresh milk, butter, honey, dried food, an egg 2 or 3 times a week.—"Your Diet in Health and Disease" by Harry Benjamin, 5s., Health for All Publishing Co., 38, Longham St., London, W. 1.

Sáttwika, *Rájasa* and *Támas* Foods.—Practical rules are given in the *Vedánta* and some distinguishing features are mentioned in the *Gitá* regarding these three classes of foods. Those whose smell and taste are not vitiated by intoxicants, repeated smoking, great use of strong spices, habitual use of rotten foods, etc., they can distinguish

foods of these classes by their senses. Whatever is *Sáttwika* is conducive to health, equable temper, strength, and long life. Whatever is *Rájasa* is stimulating to taste, but disturbing to the digestive organs, the nervous system and the mind;—in the long run they produce diseases. Whatever is *Támasa* is degrading, and disease-producing. Such foods are allowed only to those who do not care to live a high life. *Sáttwika* foods are the proper foods of students, scholars, teachers, judges, doctors, devotees and the like. *Sáttwika* foods are mild-tasting and free from all trace of foul smell. *Rájasa* foods are pungent, astringent, bitter, caustic or corrosive, sour, excessively sweet, or of any keen or stimulating taste. *Támasa* foods are known by their foul smell, such as, flesh, garlic, onion, stale or rotten foods, impure fat, and adulterated ghee, or sweetmeats, salted fish, bad-smelling cheese, preserved meat, etc.

(1) Protein Foods:
Animal:—Lean meat, fish, eggs, milk.
Vegetable:—Nuts, beans, peas, lentils.
(2) Fats and Oils:
Animal:—Fat meat, butter, cream, lard.
Vegetable:—Nuts, oils, etc.
(3) Carbohydrates:—
(A) Sugars:—Honey, cane-sugar, beet-sugar, dried fruits.
(B) Starches:—
(a) Cereals:—Wheat, maize, rice, barley, etc.
(b) Vegetable:—Peas, beans, lentils, potatoes, bananas, etc.

(4) Purifying Foods:—

(A) Fruits:

(a) Acid fruits:—Pineapple, lemon, orange, grape-fruit, tomatoes, all berries, etc.

(b) Sub-acid and sweet fruits:—apples, pears, peaches, apricots, grapes, cherries, plums, figs, etc.

(B) Vegetables:—Cabbage, onions, carrots, turnips, cauliflower, green peas, cucumber, etc.

(5) Water:—Non-mineral in all the above groups, Mineral in the usual form.

Beverages:—The finest drinks undoubtedly are those made from fresh fruit juices, and the juice of one or two oranges first thing in the morning, or the juice of half a lemon in a glass of hot water at night will be found to have a most beneficial effect upon the kidneys and the internal functions of the body generally.

Acid fruits:—People have a wrong notion that, *acid* fruits form acid material in the tissues. On the other hand, acid fruits by virtue of the abundance of alkaline mineral salts they contain, have a directly opposite effect. Their reaction in the system is alkaline. Remember that starches, sugars, fats, and proteins form acids in the system, not acid fruits.

Foods having Nutritious Elements

Foods rich in Iron—Figs, raisins, dates, lentils, spinach, radish, tomato, carrot, grape, orange, lemon, whole wheat, eggs, dried beans, dried peas, almond, etc.

Foods rich in Phosphorus.—Milk, egg yolk, dried peas, dried beans, almonds, wheat-bran,

radish, pumpkin, cucumber, unpolished rice, grape-fruit, etc.

Foods rich in Calcium (Lime).—Milk, butter-milk, cream, dried figs (white), carrots, black-berries, limes, whole-barley, lemons, onions, etc.

Foods rich in Magnesium, Sodium, and Potassium.—Potatoes, sweet potatoes, turnips, onions, carrots, beet-root, egg-plant, pine-apple, orange, lemon, grapes, spinach, radish, etc.

Books on *Foods*

(1) "*Food*" by Col. Mc Carrison, price 0-12-0, can be had from Thacker and Co., P. B. No. 190, Bombay.

(2) "*Khádya*" (in Bengali), by Dr. Chuni Lal Bose, M.B., Rs. 2/-, can be had from the principal Bengali book-sellers of Calcutta.

(3) "*Balanced Diet*", approved by Sir R. McCarrison, I.M.S., Director, Nutrition Research, Coonoor, -/4/-, can be had from Bombay Presidency Baby and Health Week Association no. 10, Delisle Road, Parel, Bombay. The Doctor writes:—This pamphlet solves the problem "how to obtain a reasonably good diet from Rs. 5 to 7 per month. It should be circulated widely, its principles taught in the schools and practised in the homes of the people."

(4) "*Diet of the Indians*", compiled by Experience, price 0-8-0, can be had from J.C. Basak, P.O. Dayalbagh (Agra) or 363, Upper Chitpore Road, P.O. Beadon Street, Calcutta.

Some Hints on Diet

"The value of milk, eggs, vegetables and fruits as balancers of diet, i.e., foods that will

remove the defects in the common diets, has been emphasised. As, however, these foods are costly they are not eaten in sufficient quantities by the poor." They should use soya beans, dried skim-milk, fresh bran or polishings of rice and fresh oil-cakes (of groundnut) as cheap and yet nutritious food-stuffs that might to a great extent serve as substitutes for more costly foods."

Sir Robert McCarrison has shown by analysing the diets commonly eaten by various communities in India that "they are not as a rule insufficient in quantity, but are often defective in quality.** The poor Madrasi and Bengali diet was found to be very deficient in proteins, fats, vitamins and mineral salts."

The prices of above mentioned diets of the poor are:—*Soya Beans* Re. 1-8 per maund, (A. B. Godrej and Co. Delisle Road, Parel, Bombay). *Dried Skim Milk* at about as. 5 a lb., in tins of 56 lbs. (Martin, Harris Co., Graham's Buildings, Parsi Bazar Street, Fort, Bombay).

Fresh Groundnut Cake (by the expeller process) at about as. 12 a maund (from Prabhat Oil Mills, Sardar Bazar, Sholapur). It keeps well for about a month. Fresh Rice Bran sells at about as. 8 per maund. It should be procured in local mills or can be gathered if husked at home, because the polishings (bran) begin to go bad in 4 or 5 days. 11 parts of unpolished rice yield 10 parts of polished rice and 1 part of rice-polishings. They are valuable as food as they contain nearly 20 per cent of a fair quantity of protein and about an equal proportion of good oil. They are also very rich in food-salts and

vitamins. The *unadulterated* bran is not coarse, but has a pleasant sweetish taste and can be used in curries or in flour. We can use $\frac{3}{4}$ oz. of rice bran in the daily diet.

Composition of the Bran of Wheat and Rice.

		Wheat	Rice	
1.	Salts of calcium, iron, phosphorus	6·0	8·7	p.c.
2.	Proteins of fair quality ...	16·4	19·0	„
3.	Fats of good quality ...	3·5	20·0	„
4.	Vitamins B_1, B_2, and E ...	+ + +	+ + +	
5.	Carbo-hydrates ...	43·6	43·0	p.c.
6.	Cellulose and fibre ...	18·0	1·0	„
7.	Moisture ...	12·5	8·3	„

The best course is to give up the habit of using polished rice and to use the flour of unpolished (whole) rice as we do of wheat. *Parboiled rice* (*Siddha* rice) is partly boiled rice and, therefore, partly denuded of salts. But it retains much of the vitamins and salts of the original grain (paddy). It is, therefore, lower in the nutrition scale than the unpolished raw rice, but higher in the scale than polished rice. Excess water should not be added to the rice and then thrown away as is usually the practice. It is a wasteful method because the natural salts in rice are thus lost to us.

Sprouting Seeds.—The process of sprouting generates not only *malt*, but vitamins A and C also at no extra cost. Sprouted grains and seeds are, therefore, an excellent source of these vitamins for the poor. Sprouting improves the flavour of the pulse seeds. Unsplit *dáls*, grams, peas, *múg*, or any other *whole* grain is soaked in water for about 24 hours and is

then spread out on damp sackcloth. This is covered by another piece of sackcloth and a light plant of wood is placed on top in cold season to maintain warmth. It is kept moist by sprinkling water from time to time. After about two days the grains will have sprouted and be ready for use. They should be eaten raw in the form of *Chutney* or as salad with curd or oil.

Pulses should as far as possible be ground into flour and then used. In this way they are cooked easily and the pulse proteins are digested better.

Vegetable Oils should be poured in a flat vessel and exposed to the sun's rays for a few hours when the sky is clear and free from dust. Vitamin D is thus developed in them.

Butter and *Ghee* are more digestible than, and are richer in vitamins than vegetable oils. For vegetarians, this is the only source of animal fats. *Butter* is more digestible than *ghee*. It is also richer in vitamins than ghee, as it is not subjected to prolonged boiling.

Dried Skim Milk.—Milk from which cream is extracted is sprayed under high pressure into vast drying chamber. Warm filtered pure air absorbs the moisture and the solid portion containing proteins, sugar and salts quickly drops down as a soft powder. The powder represents nearly 55 p.c. of the original energy value of whole milk.

Vegetables.—All leafy vegetables, such as cabbage, spinach (*pálak*), turnip-tops, radish-tops, tomato, carrots, etc. are rich in mineral salts and in vitamins. They should, therefore,

form a considerable portion of the diet of the rich and poor alike. Some of these vegetables should be eaten raw as salad—an ounce or two a day—in order to secure a sufficient amount of vitamin C which is destroyed if they are cooked. Vegetables prepared with salt, vinegar, lemon-juice, oil and pepper are callad *Salad.*

Cookers.—In ordinary cooking vitamins A and B are slightly damaged. If foods are steam-cooked in closed vessels, these vitamins are unaffected. The food also does not get charred or smoked, and the natural flavour of the food is retained.

Effects of Cooking.—It is superfluous to state here that if foods are not cooked properly, the nourishing and health-giving influences and vitamins are lost, and they become difficult to be thoroughly chewed, insalivated and digested. There are different processes of cooking, such as, boiling, baking, frying, stewing, steaming, half-boiling, etc. Different foods are to be treated in different manner, for example, rice is to be boiled with a fixed quantity of water, so that no gruel is left. Sanitary cooking is somewhat different from the methods adopted by the so-called 'civilized' or ignorant people. The health books for schools, colleges and the public should contain a chapter on Cooking for the Sake of Health. Ladies should be well-trained in this kind of sanitary cooking.

Exhibits of Food Articles

The following Food-articles should be collected in the Museum :—

I. About 12 principal kinds of paddy and rice; cereals of India, varieties of unsplit and split pulses, starchy foods (6 or 7 kinds). II. Imitations of tubers, vegetables and pot-herbs; III. Imitations of fruits, nuts; dried and preserved fruits. Some kinds of *gurh* (from sugarcane, *tárh, khajúr*), sugar, crystallised sugar (from sugarcane and *tárh*-juice), glucose, saccharin (a coaltar crystalline product), etc. IV. Milk-powder, sugar of milk in powder and globules. V. Malt, malted milk, 3 or 4 kinds of chemical foods, sanatogen, etc. VI. Four or five kinds of edible eggs; pictures or imitations of edible animals, birds and fishes. VII. Some varieties of baked foods, etc. VIII. Edible Oily Seeds and Oils.

Note:—The limited space at my disposal does not allow me to give a detailed list of Food Exhibits.

II

ORDINARY DRUGS

They can be classified into the following groups:—

1. Spices and Condiments ;
2. Vegetable Drugs ;
3. Mineral Drugs ;
4. Animal Drugs ;
5. Chemical Drugs ;
6. Mixtures and Compound Medicines.
7. Intoxicants.

I am giving only the lists of some principal Medicines, under these classes.

1. SPICES AND CONDIMENTS

These are chillies, tamarind, mustard, *zirá*, cardamom, ginger, black pepper, cinnamon, salt, etc. They are used chiefly for their flavouring and appetising purposes. They do not add to the nutritive value of the food as a whole. Seeds used as condiments have the properties of seeds in general, being rich only in vitamin B.

In cooking use only so much spices or condiments as is necessary for flavouring. Excess will not only spoil the food, but will irritate the tongue, mouth, alimentary canal, lining of the stomach, and even the intestines down to the anus. All have observed the burning sensation at the anus on account of excessive use of chillies, mustards, etc. Immoderate use of them will produce flatulence, indigestion, vitiated taste, retard digestion, create hankering for them more

and more, and other evil effects. Even common salt should be sparingly used.

These spices and condiments are often used as domestic drugs by householders and medical men with success.

Exhibits of Spices and Condiments

A list of principal Spices and Condiments is given below. In this book I cannot afford space for recording their medicinal properties. Dr. Kartik Chandra Bose, M.B., has published the properties sent by me in his monthly journal *Health and Happiness* for March 1934,—45, Amherst Street, Calcutta.

1. Turmeric (*haldi* H., *halud* B.)
2. *Dhaniá* (Hin. and Beng.), coriander seeds, unhusked and husked.
3. Chillies (*lálmarich* H., *lankå* B.)
4. Black pepper (*káli marich* H. and B.)
5. Cloves (*long* H. and B.) *Labanga*, Sans.
6. Cardamom major (*bari eláichi* H. and B.)
7. Cardamom minor (*chhoti eláichi* H. & B.)
8. *Methi* H. and Beng., Fenugreek Eng.
9. *Tejpát, tej patrá* Sans., Cassio leaves E.
10. *Zirá* black, H. and Beng.
11. *Zirá* white, H. and B., Cummin seeds.
12. Aniseed, *saunf* H., *mauri* B.
13. *Ajwan* H. and B., Ptychotis Eng.
14. Mustard, *sarson* H., *sarisá* B., red, yellow, white varieties.
15. Mustard (*rai sarisá* for blisters)
16. Ginger (*ádrak* H., *ádá* B.); keep imitation and dried ginger.

17. Saffron, *záfrán* H. and B.
18. Cinnamon, *dálchini* H. and B.
19. *Jaitri* H. and B., *Jábitri* Sans., Mace Eng.
20. Catechu, *katthá* H., *khayer* B.
21. Asafoetida, *hingh* H. and B.
22. Camphor, *karpur* H. and B.
23. Tamarind, *imli* H., and *tentul* B.
24. Garlic, *lasun* H., *rasun* B.
25. *Alubokhárá* H. and B.
26. Vinegar, *sirká* H.
27. Salt of different varieties,—(a) *Khári nimak* H., *khári nun* B.; (b) Refined salt; (c) rock-salt; (d) *saindhaba laban*; (e) Black salt, *kálá nimak*; (f) *Beet nimak* H., *Beet nun* B.
28. Betel-nut, *supári* H. and B., 2 or 3 kinds. *Chikni supári* H. and B. (prepared by some process).
29. *Ajmod* H., *Rándhuni* or *Chandani* B., Parsley or Wild Celery Eng.
30. *Soyá* H., *sulphá* B., the Dill Eng.

2. VEGETABLE DRUGS

(1) *Bael* leaves, (2) *Jasthimadhu* Sans. and Beng., Mulhatti Hindi, Liquorice Eng., (3) *Tulsi*, and its seeds *Tokmári*, (4) *Isbgul* Hindi and Beng., (5) *Sonámukhi* Beng., *Sanác* Hindi, Senna Eng., (6) Rose petals, (7) *Harh* Hindi, *Haritaki* Beng. and Sans., (8) *Baherá* Hindi and Beng., (9) *Amlaki* Hindi and Ben., (10) *Pipul* Hindi and Beng., Long-pepper Eng., (11) Papaya, *Papitá* Hindi, *Pempe* Beng., (12) *Amaltás* H., *Sondál* B., Cassia Fistula Eng., (13) Rind of Orange, (14) *Káli Marich*, Black Pepper, (15) *Pán*, Betel-leaves, (16) Betelnut, *Supári*, (17) *Bábul* Hindi, *Bábla*

7. INTOXICANTS

The principal intoxicants used by the people of India are:—1. Country wines, 2. Foreign alcoholic liquors (such as, ale, beer, wine, champaigne, sherry, port, gin, whisky, rum, brandy, etc.) ; 3. Opium and its preparations,—*Guli* and Chandu (used for smoking); 4. *Bháng* or *Siddhi* (used as drink); 5. *Gánjá* and *Charas* (for smoking); 6. Cocaine; 7. *Májum* (a confection of *bháng*); 8. Tobacco. Most of these intoxicants are used as medicines in small doses. Their medicinal properties are to be found in medical books. When they are used as intoxicants, they have poisonous effects on the body and mind. Snuff, smoking, and chewing tobacco have very disastrous effects on the human system ;—because tobacco contains a deadly poison called nicotine. We should shun all intoxicants as poisons.

All students of schools and colleges, and all persons, males and females of India, should be taught great physical, mental, social, and economic losses of India from using intoxicating drinks and drugs. Although no statistics are available, yet it can be fairly stated that the people of India annually lose 50 to 70 crores of rupees for using intoxicants. In addition to this vast loss of money, there is incalculable loss of health and moral sensibilities of the poor people on this account. If millions of rupees are monthly spent to educate and induce the people to leave off the habits of intoxication and smoking, the money would be well-spent. Text-books in English and vernaculars on Temperance are imperatively necessary. The importance of Temperance education cannot

be too emphatically impressed. All teachers should abstain from all intoxicants; and all educated men should denounce these filthy ruinous articles. Intoxicants are deadly enemies of India as well as of other nations, and as such should be shunned and hated by every Indian who expects regeneration of this fallen country. Students should be specially educated to strongly hate these abominable articles, because they are ruining India. In England "Drink has been the cause of a curse more terrible, because more continuous than war, pestilence and famine combined." — (Prime Minister *Gladstone*). No school or college of India should neglect this most important function of education. Every Museum should be provided with popular Temperance Literature in English and vernaculars. There are hundreds of suitable temperance books available in England and U.S.A. Some of them can be had from the Temperance Book Depot, 5, Russel St., Calcutta.

MEDICAL APPLIANCES

1. Measure-glasses. 2. Tea-spoon, Dessert-spoon, Table-spoon. 3. Feeding bottle. 4. Glass syringe (small and large). 5. Eye-dropper. 6. Eye-cup or Eye-wash. 7. Medicine-glass. 8. Cup (half covered) and saucer. 9. Porcelain pestle and mortar. 10. Touch-stone, pestle and mortar. 11. Sponge (genuine and artificial). 12. Glass stirring-rod. 13. Clinical thermometers (1 minute and 5 minutes). 14. Stethoscope (for two ears). 15. Glass cup. 16. Glass jug. 17. Bed-pan.

18. Urinals (for male and female). 19. Sanitary spittoon. 20. Glass-stoppered phials. 21. Nipple (sanitary). 22. Milk-feeder for babies. 23. Knives, scissors and forceps. 24. Balance and Weights. 25. Douche (with rubber tube and nozzles). 26. Ice-bag. 27. Air-cushion. 28. Boracic lint and cotton, ordinary cotton gauze, and safety pins. 29. Clean linen. 30. Sticking or Adhesive plaster. 31. Catheter (for male and female). 32. Splints (5 or 6 kinds). 33. Spatula. 34. Bottles and Phials (small and big with corks). 35. Magnifying glasses. 36. Rubber hot-water bottle. 37. Flannel for fomentation. 38. Vibrator. 39. Battery box. 40. Truss (single and double). 41. Oil, gas or spirit stove. 42. Vaseline (yellow and white). 43. Olive Oil, Cocoanut Oil, Oil Eucalyptus, Castor Oil. 44. Turpentine. 45. Alcohol. 46. Distilled Water. 47. Permanganate of Potash. 48. Lysol. 49. Carbolic Acid. 50. Glycerine. 51. Paraffin and Paraffin Oil. 52. Neem Soap, Chalmugra Soap, Disinfecting Soap, etc. 53. Ivory Spoon for Globules. 54. Syringes for Eye and Ear. 55. Appliance for stopping Mouth-Breathing, etc.

METHODS OF CURE & MENTAL CURES

Introductory Books on Various Systems of Treatment should be collected for the Museum Library. In the January and February 1937 issues of "Health and Happiness" you will find short descriptions of the following; 1st—"Systems of Curing Diseases", 2nd—"Various Methods of Cure", and 3rd—"Mental Cures".

Ordinary Popular Books, Charts, Models, Pictures, etc., on Physiology, Pathology, Child-

welfare, Maternity, Bacteriology, Adulteration, Health, Hygiene, Diet, Intemperance, Exercises for Health, Contageous Diseases, etc., should be collected and exhibited.

1st—Systems of Curing Diseases

1. Naturopathy
2. Hydropathy
3. Helio-Therapy
4. Chromopathy
5. Osteopathy
6. Chiropractic
7. Tissue Remedies
8. Homeopathy
9. Electro-homeopathy
10. Ayurveda
11. Allopathy
12. Unani
13. Soleri-Beloti Specifics
14. Unipathy

2nd—Various Methods of Cure

1. Deep Breathing
2. Radio-Therapy
3. Radium Cure
4. Laughter as a Medicine
5. Treatment by Music
6. Mesmerism
7. Thermo-Therapy
8. Oxypathy
9. Ozone-Therapy
10. Massage & Vibration
11. Diet Cure
12. Fasting Cure
13. Self-Massage
14. Mineral Springs and Wells
15. Changes of Climate
16. Mechano-Therapy
17. Electropathy
18. Iriso-Diagnosis
19. Hygiene
20. Regular Exercises
21. *Pránáyám.*

3rd—Mental Cures

1. Hypnotism
2. Cure by Self-suggestion
3. Mind as a Factor of Health
4. Cures by Prayer
5. Influence of Mind over *Prán*
6. Influence of Mind over Foods

7. Cures by Faith
8. Curses and Blessings
9. Influence of Feelings on the Nerves
10. Injuries of Violent Passions
11. Secrets of Keeping Young
12. Strong Mental Feelings produce Diseases
13. How to get rid of Pain.

III

DRESSES

Writers on antiquity have written a number of illustrated books regarding the dresses of ancient nations. Anthropologists have collected and exhibited the dresses of the savage and aboriginal tribes of India in the "Indian Museum". The people of the different provinces of India wear different varieties of dress. The costumes of the Mogul emperors considerably differ from those of the Rajput chiefs,—three, four or five centuries ago. The rapid change of the dress of Englishwomen in course of half-a-century is radical,—they have discarded the loose gowns, 2 to 4 feet diameter at the bottom, and adopted tight short dress, which shows most parts of the body naked. Educated Indian ladies should not ape them in this matter. Majority of the Indians are still using *dhotis* and *chádars*. Poor people cannot afford to buy even *chádars*. Let the people of different provinces of India wear different dresses according to their climate,

means, circumstances and customs. But great reform in the dress of Indian students should be made. The teachers and guardians should explain to the boys the utility of wearing, at least in school, knickers, pants or *pájámás* and shirts or coats,—under-coats and overcoats or wrappers when necessary,—and simple head-dress (caps or hats). If they wear *dhotis*, they should not wear them in the usual loose manner, but wear them tightly. Knickers and *pájámás* are cheaper and more lasting than *dhotis*. The school-going grown-up girls should wear knickers and undercoats underneath their *dhotis*. Little girls should wear knickers and blouses. Tight dress is imperatively necessary when swimmimg, in athletic sports. And when drilling, scouts and girl guides require tight dressing.

In the Museum, photographs of males and females of different nationalities of India wearing different dresses should be kept. Pictures of the present-day dresses of Englishmen, Japanese, Chinese, Turks, etc. might be collected for comparison with our dresses. The pictures of the uniform dresses of the Army and Navy are given in books on the subject.

Pictures of the different head-dresses of the Indians of different religions and nationalities will be interesting shows. The dresses for the neck, body, legs and feet, and some varieties of foot-wear should be shown in pictures. Straw-shoes or nailed-shoes of travellers used over snow-capped mountains will be interesting things. High-heeled shoes of English ladies should be exhibited and their injurious effects on the body should be

explained. Pictures of the various dresses of the savages or aboriginal tribes of India and other countries will be interesting additions.

IV

ORNAMENTS AND JEWELS

The women of India are very fond of ornaments, although some of them are uncouth, heavy, uncomfortable and insanitary. Some wear so many ornaments over their hands and legs; fingers and toes; neck, chest and loin; ear, nose and hair, that the parts covered by ornaments cannot be washed properly. Some tight ornaments press down their muscles, and obstruct circulation of blood. Some women of the Madras Presidency wear such heavy ear-rings that flesh of the ears is elongated downwards, and some ladies of Sind wear big nose-rings 6 or 7 inches in diameter. Poor women sometimes decorate their bodies with bronze (*ḳánsá*) ornaments, sometimes guilded with silver or gold. This custom is followed to hide one's slender means to wear silver or gold ornaments.

Too many ornaments do not enhance the beauty of women. The fair colour of English ladies and women of Kashmir are enchanting enough without ornaments. Beauty lies in the fair and healthy complexion of the skin, well-shaped face and symmetrical formation of the different parts of the body. Poor women of India wearing heavy or too many ornaments, but dirty clothing over unclean body are cadaverous to

look at. Too many ornaments hamper the free movements of the organs. Several thefts and robberies are committed in ill-protected villages on account of storing ornaments. In the Museum, pictures of principal ornaments, and some brass or copper ornaments guilded with silver or gold might be shown. Ornaments made of glass or conch-shells or lac, which cover a large portion of hands, are often used by Indian women.

An educational Museum should contain glass imitations of some jewels or precious stones. Some cheap kinds of them should be collected in originals, to give an idea of them to the students. The glass imitations of some famous diamonds, emeralds, rubies, etc. of the world, exactly in shape, size, cutting and colour can be procured from some firms of England.

V

HOUSEHOLD UTENSILS

Miniatures, pictures or originals of household utensils should be exhibited. Some utensils of glass, porcelain, and some other materials, or enamelled which do not rust or which can be easily cleaned must be collected. They are cheaper and more sanitary than metallic ones. What the kings of ancient times had not the good fortune to make use of these cheap utensils, the modern inventions of arts and sciences and power-machines are producing them in enormous quantities. We should take proper advantages

employed in the building and five men lost their lives during the works. Before anything is done towards the building a series of try-out models is made. From a hundred drawings—often there is a open competition—three or four will be selected for final choice. In the case of one notable sky-scraper, five actual models were made and two distinct styles of architecture were shown in them—Renaissance and Gothic. In course of two years or less the sky-scraper was in use !

(3) *Panama Canal.*—It is said of the Panama Canal that it cost "a life for every foot," for the French company, under De Lesseps, who attempted the task first, reckoned without the mosquitoes which infested the canal region carrying malaria and the deadly yellow fever. The idea of cutting a way through at Panama is nearly 400 years old. The French company first began operation in 1881. Then men died off like flies. The mosquito had beaten man and driven him out. A new company, under American control, took up the work in 1889, the first task being that of making war on the mosquito. The fight was a long one, but the last epidemic of yellow fever took place in 1905. The canal was finished, with depth of 40 to 45 feet, and opened in 1914. The passage of 50 miles is made in less than 10 hours. About 3000 vessels make the passage each year and the number is rapidly increasing. The Panama Canal is said to have cost in all about £ 75,000,000.

VIII

LAND, WATER & AIR VEHICLES

I believe that all persons of inquisitive tendency feel interest in seeing the pictures with short descriptions of the modes of transit and travel in land, water and air in the ancient and modern world. Young students will surely feel amusement and acquire some knowledge in seeing the pictures and reading about them. I am at a loss to find out the cause of depriving them of the pleasure and instruction by neglecting to make a collection of these pictures in museums, schools and colleges at a trifling cost.

Allow me to give here lists of pictures of the following three classes of vehicles,—(1) Land Vehicles, (2) Water Vehicles and (3) Air Vehicles in order to facilitate the collections of them.

1. Land Vehicles

Use of Man-power

Carrying children in bags.

Carrying men on the head in a basket.

Dándy carried by 4 men at hill-stations of India.

Doly made of bamboos and ropes for carrying women and invalids.

Chaturdol (8 men carry bridegrooms on it in Bengal).

Single-wheel cart 4 seats at the 4 corners used in China.

Palánkeen (carried by 4 bearers).

Sedan chair for single person (carried by 2 men in England).

Perambulator (for babies drawn by a man).

Rickshaw (two wheeled).

Monocycle, bicycle and tricycle.

Wheel-barrow (two-wheeled carriage for heavy weights).

Bamboo carts (two-wheeled for carrying heavy weights).

Stretcher (for carrying an invalid or injured man on canvas-bed).

Skate (a metallic runner with a frame fitting the sole of a shoe, for gliding on ice, or for playing over a smooth ground).

Skis (one pair of long strips of hard wood, bound on each foot, and used for gliding over snow).

Toboggan (a kind of sled made of a thin board or boards curved up at one end for sliding over ice).

Sleigh (a vehicle on runners for use on snow or ice).

Use of Animal-power

Riding on horse, mule, ass, ox, buffalo, camel, yak, goat, etc.

Ekka	(two wheeled).	Camel cart	(4 wheeled).
Tonga	do	Landau	do
Rath	do	Phoeton	do
Bullock cart	do	Chariot	do
Buggy	do	Palankin carriage	do
Dogcart	do	State carriage	do
Brougham	do	Stage coach	do

By Steam, Petrol or Electricity

The famous steam-engine *Rocket* built by George Stephenson, which won a prize of £ 500 a century ago, had a speed of 30 miles per hour.

Now fastest trains worked by steam-power run at 80 miles per hour.

Tramcars worked by electricity generally run at 10 to 20 miles in cities.

Motor car (worked by petrol, highest speed 250 miles per hour).

Motor cycle (highest speed 150 miles).

Motor tricycle	Motor lorry
Motor taxi	Motor van
Motor bus	Train (on monoline)

Millions of village people can form some idea of these vehicles by seeing their pictures.

Underground Railways of London

Seventy years ago there were 1,500,000 people living in London. But now 8,000,000 persons live in Greater London, which is 700 sq. miles. For the easy transit of the people there are 50 miles of twin tube tunnels for electric railways. The trains which run in these tubes are smaller than those used for regular surface lines and in many respects unusual. The tube stations are surrounded by shops, in ticket offices, there are ticket issuing machines, the newest of which also give change at the same time, as issuing tickets. Giant electric lifts and constantly moving stairways known as escalators lead the travellers down to the lower parts of each station where the platforms are situated. Further notices and brilliant lights guide and help to make the underground premises cheery; and the whole of the underground systems are supplied with fresh air at a constant temperature. As each train of between three and six carriages roars into the

station and comes to a stop, the doors throughout the whole length of the train fly open by sliding apart. Passengers alight and the travellers on the platform quickly step abroad, the doors are closed and within a few seconds the train is on its way. There are several ingenious electric devices for the safety of the trains and passengers. No parcels, mails or luggage are carried on the underground trains. Although trains can run faster, but on account of large number of stops, the average speed is 25 miles per hour. More than two millions of passengers are carried safely every day and night. Nearly 2,000 signals are used to work the trains, and 2,000 carriages are in service. There are 194 stations, 171 lifts, and 85 escalators, 102,000 lamps are kept burning, and 230,000,000 cubic feet of purified air are pumped into the tunnels daily. At the time of busiest pressure 40 trains an hour or one every 1½ minutes are run.—For illustrative pictures and more particulars see the *Modern Encyclopaedia for Children*. The nicely illustrated books *Wonder Book of Railways* and *Railway Wonders* give useful and interesting information on the subject.

2. Water Vehicles

Raft (logs fastened together for float).
Catamaran (a kind of raft; vessel with twin hulls).
Canoe (in India scooped from a palm tree).
Gondola (an Italian boat).
Folding boat (of canvas, can be carried by one man by folding).
Fishing boat — Jolly boat (of a ship)
Light-wood unsinkable boat — Sailing boat.

Racing boat (with a number of oars)	Ferry boat (for crossing rivers)
Life-boat (with flat broad surface)	Pinnace (used in the Ganges)
Life-buoy	Junk (used in China)
Barge	Kashmir house-boat
Circular boat	Umbrella boat (with umbrella-shaped sail)
Yacht	Amphibious air-craft
Steamer	Seaplane
Battleship	Submarine
Flat	Liner
Schooner	Cruiser
Parque	Motor ship
Sailing ship	Ships of ancient times

Motor boat has a greatest speed of 110 miles per hour.

The largest steamer on the seas today in the "White Star Liner" is *Majestic*. She has a gross tonnage of 56, 621, a length of over 900 feet, and is 100 feet wide at its broadest part. Such a ship is like a floating city, with shops, restaurants, hotels, tennis courts, clubs, cinema, etc. It is almost impossible to feel the sea's motion.

Plan, section, storeys and different parts of a big steamer are shown in charts published by the "American Express".

3. Air Vehicles

Balloon	Parachute
Monoplane	Biplane
Triplane	Airship (about 800 feet long)

The speed of special aeroplanes is 410 miles per hour.

Germany has produced the biggest aeroplane, named "Dox". It is a huge craft with its 12 fine engines and capacity for more than 100 passengers. The roar of the motors when they are all out is deafening.

Short description of aeroplanes and wonderful experiences of Aeronauts should be noted down in a book and it should be published for the education and entertainment of the students. Working model of a generally-used type of an aeroplane should be kept for demonstration.

IX

PAPERS AND PRINTINGS

The Museum should have a collection of principal kinds of paper, used for various purposes, such as, writing, drawing, printing, packing, book-binding, ornamentation, arts, etc. Barks, leaves, hand-made papers, etc. of old will be interesting exhibits. Different sizes of papers, such as, foolscap, demy, crown, royal, etc. and different foldings, such as, folio, quarto, octavo, duodecimo, etc., should be shown.

The art of printing has advanced a good deal in the course of the last 100 years. Samples of old and new printings should be another very interesting collection.

The gradual development from uncouth, rough printing from uneven wooden types to fine metallic types, from wooden or metallic picture-blocks to nice photo-blocks, etc., if shown in the Museum, will be a highly educative study. In

former days, printings looked inelegant on account of flimsy paper then available; but now-a-days good books are printed on tough or glazed paper. The improvements that have taken place in the art of printing should be illustrated by suitable samples.

X

WRITING, DRAWING, PRINTING AND TEACHING MATERIALS

We should show writing materials and different methods of transcription; that is, pens and pencils, old and new; copying by duplicating machines and tracings, typewritings, shorthand writings by signs, script letters or type-writers; telegraphic writings, etc.

Drawing and painting materials should be collected; such as, drawing papers, cloths, pens, pencils, inks, crayons, chalks, sauce, colours, paints, canvas, projectors, compasses, etc.

Printing materials are types, monotypes, linotypes, a small hand-press, composing sticks, wooden or metallic picture-blocks, electro-plated blocks, photo-blocks, stereotypes; litho-stone, litho-picture, litho-paper, litho-ink, chromo-litho process, small litho-press, etc., etc. All students should have some idea of modern printing.

In the course of half a century a great advance has been made in the art of Teaching, in consequence of which quite a large number of teaching articles and appliances have been designed and are in use. Some of them should

be collected. Kindergarten, Scouting, First Aid, Photographs, Magic Lantern, Cinemas, Talkies, Gramophones, Broadcasting, etc., are new methods of Teaching. Students and teachers should have some knowledge of these arts and their educative value; and it should be the duty of the universities, colleges and schools to impart this knowledge by means of appropriate illustrations placed in these museums. I am sorry that I cannot afford space in this small book for giving details of these important articles.

XI

DRAWINGS, PAINTINGS, PHOTOGRAPHS, LITHOGRAPHS & PRINTED PICTURES

Five books should be set apart for the collection of exhibits on the subjects named above. In the next paragraph I give a list of some kinds of drawings and paintings, which should be collected and pasted in first two of the books. The other three books should contain, (1) choicest photographs, X-ray photos, photo-prints, bromide enlargements, painted photographs, etc., (2) Lithographs, chromo-lithographs of 1, 2, 3, or 4 colours, oleographs; litho-stones having litho-drawings or litho-writings on them, etc., (3) Various kinds of pictures of ancient and modern arts, scientific discoveries, wonders of nature, famous buildings, scenery, bridges, underground railways, bird's-eye-views of cities, historical events and personages, astronomical wonders, etc.,—a rough list of which is given on pages 52, 53 and 54 of my

book *'Educational Museums'*. Unfortunate are the schools and colleges in which these pictures are not collected at a trifling cost. I earnestly appeal to the educationists of the country to take suitable action in this important method of education.

Drawings of principal kinds should be shown, such as, linear drawing, perspective drawing, freehand drawing, isometric drawing, enlarged or reduced drawing, brush drawing, drawing from models, pastel drawing, geometrical designs, light and shade drawing, black-board drawing, mechanical drawing by scale; pencil or ink sketches; plan, elevation and section of a house; survey plan; etc.

Paintings.—Sauce painting, water-painting, oil-painting,—such as, paintings of leaves, fruits, vegetables, flowers, insects, animals, etc.; scenery, natural phenomena, life-size or bust painting of a man; historical, mythological, imaginary paintings; copying of old paintings; ethnological or anthropological, still-life; comic sketches; etc., paintings of diseases, and of human organs; intra-uterine life; of faces, eyes, noses, lips, ears, heads, etc.; of *rágs* and *ráginis*, nine *rasas*, and nine *bhávas*, etc.

XII

STAMPS AND COINS

A museum should set apart two sections for these. Not only does these constitute an interesting hobby for school-children, but, if one sticks to the hobby for a sufficient number of years, he can make a great profit out of it. Philately is the tech-

nical name for a study and collection of postage and revenue stamps, embossed envelopes, etc.; and Numismatics is the science of coins and medals. A study of coins has helped in writing ancient history of several kingdoms. Every school and college should have a collection of at least some current stamps and envelopes, coins and medals of British India, Indian States, England, U. S. A., and other important countries, as far as possible. They should be properly arranged, labelled and preserved. Facsimiles or pictures of old or valuable coins, medals, seals, etc. might serve the purpose to some extent. Elementary books on these subjects should be kept in the Museum Library.

XIII

SPORTS, AMUSEMENTS AND TOYS

Athletic goods of common Indian or foreign sports, such as, stilts, bats, balls, materials used in hockey, foot-ball, lawn-tennis, cricket, etc., indoor games, such as, chess, cards, *pásá*, ludo, etc., should be exhibited. Pictures of gymnasium or cinema films of gymnastics, riding, fencing, boxing, swimming, cycling, wrestling, dumb-bells, bar-bells, clubs, boating, jumping, tug of war, skating, see-saw, sliding, jijutsu, muscle movements, weight lifting, motoring, golfing, races, circus, feats with animals, etc., should be shown. Illustrated books and charts on sports and games should adorn the Museum Library. Children should be entertained with toys, puzzles and curiosities.

XIV

MUSICAL INSTRUMENTS AND PLAYS

Common musical instruments of India and England or their pictures should be shown. Gramophone records of instrumental music, concerts, bands, vocal music, etc., should entertain the students and visitors from time to time. Cinemas or pictures may also show dancings of different kinds.

Teachers of science who have some knowledge of music, should explain musical sounds (octaves), musical terms, such as, *tána*, *mátrá*, *laya*, *mána*, *rága*, *rágini*, tune, notation, tone, rhythm, melody, solo, duet, chorus, choir, concert, band, orchestra, tuning, keynote, bass, ball-dance, opera, waltz, jazz-band, harmony, resonance, pitch, timber, loudness, instruments of percussion, wire-instruments, wind-instruments, bag pipes, *bháva*, *rasa*, etc., exemplified by musical instruments. A chart containing these terms and their meanings might be kept in the music section. Cuttings from a big dictionary of the terms and their meanings will also serve the purpose to some extent.

Museum should contain some notations of Indian and English musical instruments. There should be occasional performances with musical instruments, concerts, bands, songs, etc. In the library, there should be kept some elementary books on music and notation charts.

All students should be given facilities to learn to sing, individually or in chorus, some patriotic, moral or devotional songs, with or without th

accompaniment of musical instruments. Vocal music is very rhythmical and enervating exercise which gives a tone to the lungs, and agility to the other organs of the body. Music is not merely a nice recreation for the students, but it has health-giving and curative effects.

XV
GEOLOGY

Geology is the science which treats of the history of the earth and its life,—specially as recorded in the rocks. The history of the Birth of the World is an interesting study. The process of its birth must have occupied millions of years. The sun's attraction acting on the soft earth, broke off a large piece of its mass, which, in course of time, became the moon. Countless ages passed, and upon the surface of the molten globe a solid crust had formed. More ages passed, the hot earth was cooler, and at last there came a time when the hydrogen and oxygen in the cloudy envelope united and formed steam. Then by ceaseless torrents of rain, the entire earth was probably covered with water. But, meanwhile, the earth's crust was steadily cooling, and as it cooled it crinkled into high lands and low lands; and the high lands, rising above the steaming seas, became the first continents. Some scientists think that 150,000,000 years may have elapsed since the earth formed a solid crust. From a picture of the Tree of Life, we can get a rough idea how from Protozoa (single-celled ani-

mals), worms, molluscs, fishes, crustaceans, reptiles, amphibians, birds, mammals, curious extinct animals, apes, man, etc., gradually came into being. Thousands of years ago, men were not better than brutes. In course of centuries their brain, body, intelligence gradually developed. Still in the 20th century sometimes, even in the so-called civilized countries, their brutish nature prevails, as is seen in blood-thirsty wars, in which more men are killed than those eaten by cannibals and ferocious animals.

The diameter of the earth is 8,000 miles,—the solid crust of which is about 30 miles in thickness, below which there exists molten metal. Around the earth of the present time, there is an atmospheric cover 40 or 50 miles thick. Beyond it is space, so cold that it is 200 degrees below zero. About 5 miles above the earth, the air is so rarefied that it is difficult to breathe there; and the temperature there is icy cold; and it is nearly dark, even when the sun is shining, because the rays do not produce light or heat in such rarefied air, and it is well-nigh ethereal region. Aeroplanes cannot go up to 8 miles, or above. The pilot's eyeballs will become solid like ice-balls and he cannot breathe such attenuated air.

"At every 60 feet below the surface of the earth, the temperature rises 1° Fahr. At the depth of 2 miles, the water would be at its boiling point; and at the depth of 25 or 30 miles, the metals would melt. But the most impressive evidence as to the earth's internal high temperature is furnished by volcanoes. At the present time, there are, it is said, some 300 or 400 volcanoes."

Geology treats

(a) of the structure and mineral constitution of the globe (structural geology); }

(b) of its history as regards rocks, minerals, rivers, valleys, mountains, climates, life, etc. (historical geology);

(c) of the causes and methods by which its structure, features, changes and conditions have been produced (dynamical geology).

Stones are classified into 3 groups:—

1. Sand-stone = a stone composed of worn, rounded grains of various other stones or mineral substances arranged in layers. Sandstones may be red, white, green, yellow or indeed of any colour;

2. Granite, which is composed of (1) Felspar, (2) Mica, (3) Quartz.

3. Chalk = a stone formed out of the remains of once-living animals.

(1) All rocks having characters like those of sand-stone are Sedimentary Rocks;

(2) Those formed, as chalk is, of the remains of plants or animals, are Organically-formed Rocks;

(3) Those having a crystalline character, like the granite group, are Igneous Rocks;

(a) The layer of coarse mineral particles deposited in water is a Sediment of Gravel.

(b) The layer of small particles of sand is Sediment of Sand.

(c) The layer of mud or clay is Sediment of Mud.

Definitions of Geological Terms

(1) A piece of *Conglomerate* or pudding stone is made of little rounded stones cemented together.

(2) A piece of *Sandstone* is a compact mass of grains of sand.

(3) A *Shale* is a stone formed of hardened, fine muddy sediment.

"One leading feature of sedimentary deposits laid down under water is that they are assorted and spread over each other in regular layers. This kind of arrangement is called *Stratification*. The rocks stratified in this manner are called *Stratified Rocks*."

"*Fossils* are *organic remains* imbedded in stratified rocks. *Peat* is a decomposed vegetable deposit formed of the fibres of plants firmly matted together; and when dug out and dried it is used as fuel like coal."

"As the original mud hardened into shale, the plant was more and more altered, until its substance passed into coal."

"Shells, as they die and crumble away, form a white chalky deposit, called *marl*, which is made up of shells in all stages of decay."

"*Ooze* is formed of minute organic remains."

"*Igneous Rocks* have been actually melted within the earth or have been thrown out at the surface by the action of *Volcanoes*." *Igneous rocks* are divided into 2 groups:—(1) *Crystalline* (made up of crystals), and (2) *Fragmental* (consist of the loose materials).

Specimens to illustrate the "Geology Primar" of Sir Archibald Geikie.—Sedimentary Rocks

(5 kinds). Organically-derived Rocks (7 kinds). Fossils (5 kinds). Igneous Rocks (5 kinds).

A small box containing the above 22 kinds of specimens can be procured from Messrs. Macmillan and Co. or other companies at a cost of about 15 shillings.

For a small museum, 20 kinds of Fossils can be bought for 15 shillings or so.

For ordinary students, who have not studied Geology, the following ordinary geological specimens might be kept under a popular classification. It should be the duty of teachers to explain the necessary particulars of these specimens and their uses in arts, manufactures and medicines. A small pamphlet should be published containing the names, important particulars and common uses of these specimens. This is the simple method of educating the public.

1. *Stones.*—Sandstone, marbles of different kinds, limestone, granite, slate, quartz, soapstone, agate, felspar, touchstone, pumice, obsidian, basalt, quartz crystal, fossilized stone, alabaster, flexible stone, lithographic stone, etc.

2. *Earths and Sands.*—Black earth (loose and sticky), sandy earth, alluvial soil, reddish earth, yellowish earth, white clay; sands of some kinds, silica sand, coarse sand, fine sand, sand with mica dust, yellowish sand, sand with gold dust, etc.

XVI

MINERALS AND METALS

Minerals

Mineralogy is the science which deals with minerals, studies their chemical composition, their crystalline forms, their physical characteristics (such as, lustre, hardness, specific gravity and colour), their formation, occurrences and uses. The rocks and earths may be simple minerals, as quartz and kaolin, each may be composed of several minerals, such as, granite and the complex clays.

Minerals are the raw materials from which are obtained all the metals; all acids, salts and other chemicals; glass, porcelain, pottery, terracotta, and bricks; many pigments, such as ochre and amber, and graphic materials, such as graphite and lithographic stone; fertilizers, including potash and nitrates; mineral fuels (coal, petroleum, and natural gas); and gems. A simple mineral may be the ancestor of a long line of useful derivatives. Thus common salt (sodium chloride) is the source of most of the other salts.

About half a century ago, some 1500 kinds of minerals were discovered. It is possible that up to the present 2000 kinds have been discovered, out of which only 150 kinds are generally dealt with. One metal has several compounds; such as, *copper* has about 25 compounds; *potassium* has more than 80 compounds, and so on. "Progress in material civilization has consisted largely in learning how to turn the mineral resources of the earth to use." (Dr. J.W. Mellor). Therefore, edu-

cated Indians should specially study the mineral resources of India and how to utilize them. Specimens of twenty-six kinds of minerals can be had from W. M. Welch Scientific Co., 1516, Orleans Street, Chicago, U. S. A. for about Rs. 15/-.

Coal.—The products and by-products of coal are about 50, such as, crude tar, ammoniacal liquor, crude gas, coke (soft and hard), sal-ammoniac, explosives, pitch coke, building blocks, road preparations, sulphuric acid, saccharine, crude carbolic acid, dyes, photographic and pharmaceutical chemicals, perfumes, black varnish, power, light, heat, etc. The utility of coal and iron is far greater than that of gold and silver.

Let me mention here about a wonderful coal mine at Colorado, U. S. A. In it there is a vein of coal about 5 miles long. It yields 400 tons per day. The gigantic solid lump of shining coal 8 ft. 9 in. long, 6 ft. across, and 4 ft. high, that attracted such great attention at the Continental Exhibition in 1877, being beyond all comparison, the greatest single piece of coal on exhibition, was taken from this mine. It weighed 7 tons.

Metals

According to the popular idea metals have the characteristic properties of being hard, heavy, lustrous, malleable, ductile, tenacious, and a good conductor of heat and electricity. Even with the progress of modern Chemistry, no exact scientific definition of a metal is possible. The metal lithium floats on water; potassium is soft as wax; mercury is liquid at the ordinary temperatures; antimony and bismuth are brittle.

The processes of extracting metals from their ores, refining, separating, and alloying them are included in the science of *Metallurgy* in general,—these processes include crushing and concentrating the ores, roasting and smelting.

In Chemistry 78 elements in the mineral kingdom are mentioned;—out of which some are metals and others non-metals (such as sulphur, carbon, phosphorus, silicon). There are 22 kinds of metals, out of which iron, gold, silver, copper, zinc, tin, lead, mercury, nickel, platinum, antimony, aluminium, are common varieties. The first eight metals are called *astadhátus* by the Hindus, who have from these metals prepared tools, utensils, ornaments and medicines from the ancient times. Most of the metals are seldom found in mines in their pure state. Metallic ores are purified to a great extent in furnaces or by other processes.

XVII

BOTANY AND ZOOLOGY

(Some additional paragraphs)

I have briefly explained on pages 17 to 22 of this book what should be taught to the general students. The following additional paragraphs on the above subjects will also be of great interest:—

Palm Trees

Palms are the most valuable plants of the tropics. Their trunks, fruits, leaves, juice and fibres have great economic value.

dried kernels of the nuts, about 25 gallons being obtained from 1000 nuts. It is largely used for making soaps, lubricating purposes, for cooking, smearing over the body, and adulterating *ghee*. It is used in making candles. Coconut-oil soap will lather in sea-water.

(4) *Betel-nut Palm (Areca Catechu)*.—It is cultivated exclusively within the moist tropical tracts that fringe the coast of India and practically within a belt of land that does not extend inland for more than 200 miles. The cultivated palm is met with throughout the hot damp regions of Asia and Malay Islands. It is a masticatory of great antiquity with all Asiatic races. The betel-nuts in a fully planted grove are about 6 to 7 feet apart each way. Betel-nut trees are known to bear fruit freely for 30 or 40 years. On an average each tree has two bunches of fruit, sometimes three or four. A good bunch gives 200 or 300 nuts and a specially good one about 400. Areca-nut gardens of Mysore are a profitable source of income to the cultivators and the State. After boiling the scraped nuts with handful of lime for two hours, a resinous extract is collected which is called areca *catechu*. Betel-nuts are not only very largely produced in India, but are imported from Ceylon, the Straits Settlements, Sumatra and China. The annual consumption of betel-nuts in India itself cannot be far short of a valuation of Rs. 225 lakhs. Fresh nuts are intoxicating and poisonous,—by boiling, the poisonous property is destroyed.

(5) *Sago Palm*.—The Sago Palm of Malacca and the Malaya are very commonly cultivated

in India and grow wild in the forests of Burma and Assam. Its fibres are used in Manipur to filter water. It has been recommended for ropes intended for use under water and even as covering for sub-marine telegraph cables. Sandals are made from leaf-sheath. The coarsest fibre is only fit for brush-making. The sago from the interior of the stem, although inferior to that obtained from the true sago palm, is nevertheless an article of food. One palm may give about 150 lb. of good sago-meal.

(6) *Canes or Rattans Palm.*—Few plants are more useful to the inhabitants of moist tropical regions than the canes and rattans. The stems when freshly cut contain a large quantity of liquid,—from which, by evaporation, a red resin may be obtained, which is sometimes called "East India Dragon's-blood". The true Dragon's-blood is procured from Sacotra. A fruit from cane-palm is often an edible refreshing bitter-sweet pulp. This palm owes its chief value to the great strength more particularly of the outer woody layer of their long flexible stems. As substitutes for ropes these are invaluable, and in the countries where they abound, canes 300 to 400 feet in length are frequently employed as the bearing-ropes of suspension-bridges. They are also used in towing heavy objects, stones, logs of timber, etc. The smaller canes are exclusively employed throughout the world in basket-work. Chairs, sofas, couches, baskets, etc. are constructed of entire canes wound round and round and fastened to each other by thin strips of the cane-bark. When the interstices are filled up, they

become water-tight baskets and granaries. A strong and durable floor-mat is similarly made of these canes. Canes are very largely used as walking sticks, umbrella-handles, and to give strength in saddlery and harness. The Chinese employ rattans in the manufacture of paper. Canes and rattans are imported from the Straits Settlements and Siam; and India exports them to foreign countries.

(7) *Ornamental Palms* are planted in gardens and on both sides of roads to form beautiful avenues. I do not know of any other uses of these palms. About 20 kinds of such palms are available in an Indian nursery. Research scholars should try to find out some of the uses of these palms in arts and manufactures.

Animal Life

From the tiny one-celled Amoeba to Man, there are more than half a million known forms of animals, differing enormously in size, form, colour and mode of life—in the ways they get their food, in their adaptation to the struggle for existence, in their wonderful revelation of animal instinct, often surpassing man's power of reason.

A noted scientist once said that plants are animals that have a business of standing still. This distinction will not fit in all cases, for there are a few animals like sponges and corals that remain fixed in one place. Another clear distinction is that nearly all plants get their food from gases in the air and chemical substances in the soil and water, while animals live by eating plants and other animals.

The struggle for existence in the animal world, therefore, seems fiercer and more cruel than among the plants. The three great things in an animal's life are to eat, to avoid being eaten, and to continue its kind. Throughout the animal kingdom we find the most marvellous adaptations to carry out these purposes. Thus the lion and the tiger are provided with long claws and sharp teeth for capturing their prey. The porcupine has sharp bristles to drive away an enemy; the shunk drives off his pursuers by throwing off a disgusting odour; and the flying fish leaps out of the water and escapes danger by the use of its wing-like fins. Still another example of adaptation is the bright plumage of birds, which is their show-dress during the mating period. There are also butterflies whose wings so imitate the blossoms or leaves of trees that when they are on the perpro twigs only the keenest eye can pick them out.

Animals that are not well adapted to the struggle for life soon die off and disappear. As it is, nature produces millions of animals which survive only for a brief period; in the great struggle for existence enormous numbers die when young, or are killed or eaten by other animals. If this were not the case a single species would soon over-run the entire earth. The conger-eel (a large species of sea-eel) for example, is said to lay 15,000,000 eggs. It is estimated that if each egg grew to maturity, and reproduction continued at the same rate, every ocean and sea would be full of conger-eel in ten years.

The length of life of an animal seems to be

connected in some way with its size and the rate at which it multiplies. The largest animals, which have few young, such as, the whale with a span of life believed to be 300 years or more, and the elephant, which sometimes reaches the age of 150, seem to live the longest. On the other hand certain flies which multiply very rapidly live only a few hours.

After thousands of years of study scientists have been able to trace out the general design of this great family trees. They have learned that all the animals, from the tiny one-celled *amaeba* to man himself, are related to one another and they have classified all the various kinds of animals—more than 500,000 of them—showing how they are related.

One of the simplest schemes of classification, in which the animal kingdom is divided into eight branches, is as follows:--

1. *Protozoa.* The simplest animals, microscopic and usually composed of a single cell, such as the amoeba or the malaria germ.

2. *Porifera.* Sponges.

3. *Coelenterates.* Jelly-fishes, coral animals, etc.

4. *Vermes.* Worms, a very large group, often separated into several branches; including joined worms, shelled worms, tape-worms, etc.

5. *Molluscs.* Snails, oysters, devil fishes, cuttle fishes, etc.

*6. *Echinoderms.* Animals with spiny skeletons like star fishes, sea-urchins, etc.

7. *Arthropods.* Lobsters, crabs, spiders, centepedes, bees, ants, butterflies, beetles, etc. There are 4,00,000 known species in this branch, more

than all the known species in all the other branches combined.

8. *Vertebrates* (backboned animals).

(a) *Fishes.* (b) *Amphibians.* Frogs, toads, and newets. (c) *Reptiles.* Snakes, lizards, alligators, tortles. (d) *Birds.* (e) *Mammals.* Animals that nurse their young, including man.

Some Wonderful Animals

1. *Whale.*—The whale is the hugest animal on the earth. A photograph of a whale is given in a book, the size of which measures 15 feet high, 22 feet wide, 65 feet long, weighing nearly 250 tons. He is a lung-breathing, warm-blooded mammal, whose ancestors forsook the land and launched out into the deep. Now, however, we find him surprisingly well adapted to aquatic conditions. His feet have become flippers; his tail has broadened (cross-ways, not up and down like that of a fish) into a double-winged paddle with which he swims powerfully. His nostrils, or rather blow-holes, are placed right up on the top of his snout and lead directly to his windpipe, so that they can be closed when he is under water, sometimes for an hour. When he rises to the surface, he expels the used air in two columns of vapour resembling a waterspout, and then he is said to be "blowing". The whale himself is a sort of life-buoy, and carries his floating gear about with him.

He makes his home in almost every ocean, but chiefly in the Arctic and Antarctic. A few of his kind may even be found in fresh water. One

species, the Sperm Whale, has to his head a big box filled with an oily or waxy substance which helps to buoy him up; but more important still is the thick coat of blubber (sometimes fully 20 inches thick), which the adult whale wears underneath his skin. The same property which makes oil float on the surface of water gives buoyancy to this oily or fatty sheath. The blubber may take the place of a fur coat, and is probably a much more effective way of keeping warm in the depths of the sea. Blubber may also serve the purpose of a camel's hump and help to keep the whale nourished when food is scarce. Or again it may protect him in the deeper waters. He is a great diver to a tremendous depth. Here the pressure of water is enormous; even the whale's mighty frame may suffer if it were unprotected, so he clothes himself completely, as it were, in a pneumatic tyre, and rises uninjured to the surface.

Roughly, they are divided into two great families—whalebone and toothed whales—distinguished mainly by their method of feeding. The first group is comprised of 7 kinds. They have no teeth. One of this kind called the Blue Whale is the largest of all the animals, ranging up to 100 feet in length. Instead they have great fringed plates of "whalebone",—sometimes they are quite 15 feet in length, while as many as 3 or 4 hundred have been found in a single whale. Their purpose is to strain from sea-water the minute creatures on which the great animal feeds. The whale dines simply. He merely swims along the surface with his mouth open,

while into that capacious cavern go the waves, laden with tiny creatures. The water pours out at the sides of his mouth, the creatures held back by the fringed blades are swallowed. This whalebone was one of the products for which the whale was principally hunted in the past. The whalebone (called baleen) even from a single large whale, such as the now almost extinct Greenlander, might weigh over a ton and be valued at more than £ 2,000.

A kind of the first group called sperm whale, over 60 feet long, another monster whose head reaches to a third of the length of his body. He is found mainly in tropical waters, is hunted partly for a substance (called 'spermaceti') which fills his great head cavity. Sometimes, too, masses of a grey substance called 'ambergris' are found in the interior of the whale, or floating on the sea in his neighbourhood. This substance, used in making perfumes, is exceedingly valuable, and the discovery of a considerable quantity is windfall indeed.

The toothed whales feed on cuttle fish and other large sea-creatures. Their teeth may be few in number, but they weigh up to 4 lb. apiece and are quite formidable in action. The modern whaler is a sea-worthy little steamer of 100 to 200 tons, carrying about a dozen men and mounted with a gun which fires an explosive harpoon at the whale, after killing him outright with the first shot. Abridged from the "*Modern Cyclopaedia for Children*".

2. In British Guiana there are four-eyed fish which can boast of one pair of eyes for seeing

above the water and another pair of eyes for seeing below it.

3. There is also the Railway Worm which flashes a red light at each end, carries in addition, a series of eleven green lights running the whole length of its body.

4. Sea Mouse.—Its silky hair with all the colours of the rainbow, is really a sea-worm and has a ringed body. Among the hairs of the sea mouse are strong, retroctile bristles of a most complex character, each consisting of a horny sheath carrying a barbed harpoon; and when alarmed the "mouse" can become a miniature porcupine. That, however, does not prevent the great mouths of the cod-fish, or the dog-fish, from accepting it, even when most "bristly."

5. Life-spans of some Animals:—

	years		years
Whale	500	Lion	35
Turtle	350	Cat	30
Carp (a kind of fish)	200	Hog	20
Elephant	150	Pigeon	20
Swan	150	Craw fish	20
Golden Eagle	104	Rabbit	10
Raven	100	Squirrel	6
Parrot	100	Mouse	6
Goose	80		days
Bear	50	Fly	150
Sparrow	40	Dragon fly	50
Toad	40	Locusts	28
		Moth	3

6. Penguins are among the most wonderful and interesting birds. On land they stand upright on their webbed feet, their thick legs appearing

like jack-boots, and with their black backs and white waistcoats they present an almost human appearance. They are often tens of thousands in a single community. The Emperor Penguin of the Antarctic seas stands 3 feet 6 inches. When fishing, and generally when on the sea, the penguin comes to the surface to breathe so unexpectedly, diving again almost instantly, that it is very easy to mistake it for a dolphin. One of the smallest kind, the little Blue Penguin, which is only about 17 inches high, is extremely active. Its swimming powers are so great that it stems the waves of the most turbulent seas with the utmost facility, and during the severest gale descends to the bottom, where, among beautiful beds of coral and forests of seaweed, it paddles about in search of crustaceans, small fish and marine vegetables.

7. Migration of Birds.—Of the many wonders of this wonderful world none is more amazing than the tremendous length and difficulty of the journeys undertaken by birds. Millions of birds migrate twice every year thousands of miles. The Arctic Tern literally goes from pole to pole a distance of 11,000 miles. It turns up in the northern regions when summer is beginning, at which time the sun never dips below the horizon; then, at the approach of autumn, away the bird flies to the Antarctic where it arrives just in time for continuous day light of the southern summer. Some birds are very rapid travellers. An observer who spent many years studying the subject states that a swallow can fly at the rate of 90 miles an hour, whilst the little arctic Bluethroat can nearly double

this speed, three times the speed of fastest express trains. The chief reason for migration is the need for food. How could a swift live in England in the winter when there are no gnats to eat, so it flies to the sunny south, where insect life is abundant. How do migratory birds find their way on their long journeys? The airmen have compasses and maps and direction signals, but the birds often fly so high that it is a marvel that even their keen sight can descry the land, especially during the night, when most of the flights are apparently made.

8. *Rattlesnake* is very venomous reptile. Its peculiar rattle is due to the horny, loosely jointed rings at the stump end being rapidly vibrated; just as when two pieces of bone are struck together they form a distinct musical sound. Young rattlesnakes have at first only one of these horny rings. In older snakes, the number of rings is as many as twenty or thirty. A remarkable characteristic of the rattlesnake is the powerful fascination it exerts over birds and other animals. Its bite is fatal in two minutes. The fangs, of which there are several pairs, are connected with channels which lead to the poison glands acting in the same manner as a hypodermic syringe. The rattle startles and often paralyses the victim, whether human or lower animal. The snake undoubtedly possesses some ventriloquil power, for the rattle sounds now here, now there, and this uncertainty adds to the victim's stupefaction. —"Wonderbook of Nature."

XVIII

CHEMISTRY AND CHEMICALS

Physics deals with the universal properties of matter, such as, hardness, density, etc., and the various forces (heat, light, sound, magnetism, electricty, etc.); while *Chemistry* studies those properties of matter in which their composition and interaction upon one another are concerned. *Physics* classifies substances into solids, liquids and gases; *Chemistry* classifies them primarily into elements and compounds. Chemistry has several branches, such as, Inorganic Chemistry, Organic Chemistry, Applied Chemistry, Industrial Chemistry, etc. Physical changes are temporary, but Chemical changes are generally permanent.

In course of the last hundred years, Chemistry has advanced a great deal; and chemists have discovered and manufactured a large number of new articles, which are used by mankind. Hundreds of pages are required even to enumerate them with short descriptions. For example, more than 200,000 carbon-compounds have been described. Let me give 25 examples,—

1. Acetylene, 2. Alcohol, 3. Acetic acid, 4. Carbon dioxide, 5. Starch, 6. Grape sugar, 7. Cane sugar, 8. Cellulose, 9. Albumen, 10. Gelatine, 11. Artificial diamond, 12. Lamp-black, 13. Black Lead, 14. Coke, 15. Coal gas, 16. Bone-black, 17. Peat, 18. Bituminous Coal, 19. Petroleum, 20. Hydrogen, 21. Methylated spirit, 22. Carbonic acid, 23. Carbon monoxide, 24 Benzene, 25. Aromatic hydrocarbons, etc.

Different kinds of *iron* are produced out of 7 kinds of iron-ores. Some kinds of iron are, pig iron (or cast iron), wrought iron, crucible steel, Bessemer steel or open hearth steel, tool-steel, structural steel, mild steel, etc.

Special alloys of steels are,— (1) Manganese-steel, (2) Nickel-steel, (3) Nickel-chromium-steel, (4) Chromium-steel, (5) Tungsten-steel, (6) Cobalt-steel, (7) Chromium-tungsten-steel, (8) Stainless steel, etc. These alloys are used in different tools and machines.

Although it will take some years to study fully the science of Chemistry, yet I think it proper that students should be imparted general knowledge of the broad principles of Chemistry from some elementary books on the subject, to be specially published, in which common chemical terms are explained. Some chemical samples illustrative of those terms should be collected. Teachers should explain the terms by showing the samples. This kind of teaching is possible and practicable. Students should never be kept in utter darkness regarding some knowledge of Chemistry. I believe that most of the students will feel pleasure in learning the general laws of Chemistry if explained by experiments.

Chemistry has discovered a law that in all physical and chemical changes, no loss or gain of matter takes place. Chemical changes are made by one or more of the following causes:—(1) Contact, (2) Heat, (3) Light, (4) Electricity, (5) Pressure, (6) Solution, (7) Catalytic agents.

Mixture and Compound are different terms; examples of mixtures,—air, sea-water, gun-powder;

examples of compounds,—water, salt, nitre.

Melting and boiling points of solids and liquids respectively and Freezing points of different liquids are different and constant.

Some phenomena with examples.—Vaporisation (steam), Condensation (ice), evaporation (drying of wet cloth); gases dissolve in liquids (soda-water), saturation (salt or sugar dissolved in water, to the extent that they no more disslove), Crystallisation (some crystals should be shown), etc.

Definitions of the words, element, compound, atom, molecule; list of common elements and their symbols, law of definite or constant proportions in the formation of chemical compounds,—acids, bases, salts, alkalies, crystals, etc., should be taught.

There are about 90 elements,—many of them are very rare. About 98 per cent. of the crust of the earth, to a depth of 10 miles, consists of compounds of only 8 elements, and of these oxygen makes up nearly 46 p.c., silicon 28 p.c., aluminium 8 p.c., iron 5 p.c., calcium $3\frac{1}{2}$ p.c., sodium 3 p.c., potassium $2\frac{1}{2}$ p.c., magnesium 2 p.c., total 98 p.c. In the ocean oxygen makes up 86 p.c. of the elements, and hydrogen about 11 p.c. The sea also contains about 2 p.c. chlorine (mainly in the form of common salt).

Ordinary Chemicals should be collected and their uses explained; such as edible salt (sodium chloride), saltpetre (nitre, sodium nitrate), quick-lime (calcium oxide), slaked lime (calcium hydroxide), chalk, plaster of Paris (oxide of potassium), sal-ammoniac (chloride of ammonia), blue vitriol (copper sulphate), green vitriol (iron sulphate), epsom salt (magnesium sulphate), caustic soda

(sodium hydroxide), calomel (mercurous chloride), red lead (lead oxide), soda ash (carbonate of sodium), gypsum (sulphate of lime), white lead (lead carbonate and hydrated lead oxide), zinc white (zinc oxide), soda-bicarbonate, carbon, lamp-black, charcoal, mineral coal, hard coke, coal tar, asphalt, pitch, cane sugar, sulphur, phosphorus, silicon, iodine, common metals and their ores, manganese, magnesium, naphthalene, whiting (powdered chalk); sulphuric acid, nitric acid, phosphoric acid, hydrochloric acid, carbolic acid, alcohol, methylated spirit (wood alcohol), vinegar (acetic acid), petroleum, ordinary oils, etc., oxygen, hydrogen, nitrogen, ozone, chlorine, etc.

XIX

MECHANICS AND MACHINES

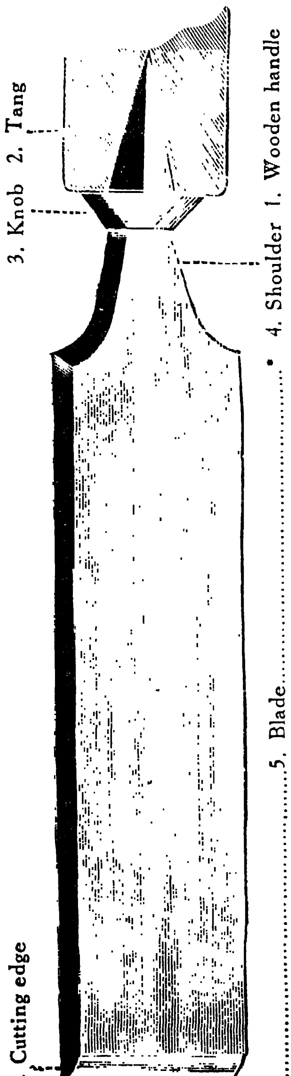
Mechanics is the science which treats of forces and of motion. Any apparatus which is used to transmit or direct the action of a force is a *machine*. Machines cannot increase the energy of any source. By modifying the action of the source of energy a machine renders it capable of performing work which could not otherwise be done. By means of a lever a man can raise a weight of 10 maunds, which he cannot raise without the lever. By means of a crane, a man can even raise a locomotive weighing as much as 20 tons. Machines are simple or compound. The simple machines are the lever, the wheel and axle, the pulley, the inclined plane, the wedge and the screw. These are called six mechanical po-

wers. All compound machines are modifications of these. In reality there are only two essentially different machines—the lever and the inclined plane; the wheel and axle and pulley are modifications of the former, while the screw and the wedge depend on the principle of the latter.

Generators of Forces are the following:—Animal or man power, steam, oil, gas, heat, hydraulic pressure, spring, electricity, magnetic force, fire (gun powder), flowing water of rivers and waterfalls, gravity (pendulum), weight, wind-power, etc.

Tools and Implements are to be exhibited; such as, chisel, hammer, saw, plane, drill, file, knives, scissors, mortar and pestle, pickaxe, punches, wrench, anvil, dies, vice, cutter, plier, screw-driver, bellows, etc.

Had I been a millionaire, I would have engaged a big electric plant for blowing 1000 trumpets and beating 1000 drums for proclaiming before the educational authorities of India the simple fact that some present nations of the world have become great and prosperous by manufactures and armaments worked by machines combined with patriotic, sacrificing and co-operative spirit; but *not* by the study of antiquity, anthropology, philology, dead languages, philosophy and similar ornamental subjects, and *never* by communal strifes and religious bigotry. Therefore, hundreds of technical Schools and Colleges should be opened for teaching the uses of at least common tools and machines.



Common Chisel Explained

A chisel has six parts:—(1) the wooden handle; (2) the square tang inserted in the handle; (3) the bulged knob at the end of the handle; (4) the shoulder, i.e., the tapering portion between the knob and the blade; (5) the flat blade; and (6) the slanting cutting edge.

1. It is a flat paring chisel for cutting wood.

2. The blade is flat and thin towards the end which is shaped like a wedge and the handle-portion is square, tapering to a point known as the tang; which keeps the blade from turning in the handle. The shoulder prevents the handle from splitting when it is struck with the hammer.

3. It is made of steel.

4. It is soft-tempered and the sharpened edge is especially hard-tempered.

5. If it be not tempered, it will bend by the strokes of hammer or mallet, and sharpness will disappear by a few strokes.

6. One of the two broad flat sides of the blade is straight, and the other is

slanting,—for when wood is cut the slanting side is used first and after chopping off the wood to some extent, the straight side is used to make a plane surface of the cut side.

7. *Question*. Why was the slanting side not made slanting from the knob to sharp edge ?

Answer. If it were so, the sharp edge will be very thin and will easily break, and secondly, the slope at the sharp end is ground on a revolving grinding stone or flat grinding stone to sharpen it. Thus, the chisel will serve its purpose, till the blade remains only one inch long.

8. The tempered steel has a more sonorous sound than untempered steel. The colour of a good tempered steel at the sharp end is somewhat purple.

9. *Question*. Why are the thin sides of the blade a little tapering ?

Answer. They are made so, to prevent resistance of the wood when it is cut.

10. The bulged knob at the middle presents a sufficient resistance to the handle when hammered.

11. The portion within the wooden handle is made tapering in order to save metal and reduce the weight of the chisel, and to easily thrust into wooden handle.

12. The handle is made of a stiff wood to bear the constantly repeated strokes of the hammer.

13. The shape of the handle is round or hexagonal for comfortably handling it.

14. The other kinds of chisels are mortise, half-round, round, hollow or grooved and conical.

15. The different sizes of the blades of wood-cutting chisels are generally from $\frac{1}{8}$th inch to $1\frac{1}{2}$ inches.

From the above detailed description of the mechanism of a Common Chisel, a shrewd intelligent man can imagine the vast experiences of the makers of tools, not to say of machines.

Illustrations of principal Mechanical Movements should be shown by pictures, or rather by models in working order. Weapons, such as, sword, dagger, bayonet, pistol, gun, rifle, etc., should be exhibited. Pictures of the principal parts of a Steam Engine, such as, cylinder, piston, crank, eccentric, safety valve, whistle, fly-wheel, governor, firebar, slide-valve, etc.; parts of motor car, bicycle, clock, etc., should be shown. Working models of aeroplane, oil engine, electric plant, etc., will be interesting.

Common Machines should be shown by pictures or models.—Lathe, Drilling and Planing machines, Punching and Shearing machines, Sawing machine, Steam-hammer, Stationary Steam Engine, Oil Engine, Gas Engine, Hydraulic Press, Pumps (Suction and Force), Grinding machine, Crushers, Screw Cutter, Screw Press, Boiler, Refrigerator, Ice machine, Soda-Lemonade machine, Spinning and Weaving machines, Printing Presses of different kinds, Crane, Dredger, Turbine, Water-wheel, Wind-mill, Cream-extractor, Motor-car, Ploughing Tractor, Husking machine, Oil Presses, Flour Mill, Locomotive Engine, Aeroplane, Marine Engine, Electric Power Generator, Clock, Watch, Cycle, Sewing machine, Typewriter, Furnace, Wheel and Axle, Pulley, Steelyard, etc.

Machines for making screws and nails, clocks and watches, bicycles, locks, house-fittings, electric fittings, motor cars, wire-nettings, ceramics, tinned sheets, rubber-articles, type-writers, sewing machines, mirrors, agricultural tools and appliances, etc. should be exhibited.

XX

ARTS and MANUFACTURES

A. Textiles :—Cotton, Woollen, Silken, Jute, Flex Fabrics, other Fabrics, such as, Carpets, Durri, Mats, Velvets, *Gálichá*, Oil-cloths, Waterproofs, Waxcloths, Tarpaulins, etc.—Dyeing and Printing them.

Raw Materials :—Cotton, Wool, Silk, Jute, Flax, Hemp, Agate, etc.

B. Hardwares :—Raw materials of pig iron, cast iron, wrought iron, steel, zinc, copper, tin, lead, aluminium, etc.

C. Metal-wares with workmanship on Gold, Silver, Copper, Iron, Brass, *Kánsá*, Tin, Aluminium, etc.—Engraving, Enamelling, and Electroplating on them.

D. Pottery, Porcelain, Glasswares, Cement, Plaster; Works on Ivory, Stone, Wood, Horn, Bone, Leather, Mother of Pearl, Precious Stones, Conches, *Sholá*, Coconuts, Lacquer-wares, Rubber-articles, Brush-works, Bone-works, Bamboo-works, etc.

E. Dyes, Paints, Colours, Varnishes, Polishes.

XXI

PHYSICS

Physics is the science of phenomena of inanimate matter involving no chemical changes.

All bodies, whether solids, liquids, or gases, have the following general properties:—extension, impenetrability, divisibility, porosity, compressibility, elasticity, inertia and gravity. Specific properties are observed in certain bodies, or in certain states of these bodies; as, solidity, fluidity, tenacity, malleability, colour, hardness, etc. Every matter or its particle or atom occupies space. A nail driven into wood does not actually penetrates it, but displaces some particles of the wood. A matter is divisible into particles or atoms. A small drop of blood suspended from a point of a needle would contain about a million of globules. All solid matter is porous, can be compressed and is elastic, in however small degree possible. Gases and liquids are elastic.

Inertia is a purely negative property of matter; it is the incapability of matter to change its own state of motion or of rest. Several instances of inertia, should be proved by examples.

Any cause capable of making bodies pass from a state of rest to one of motion, or conversely from a state of motion to one of rest, is called a *force*. The forces which tend to resist or destroy motion are called *resistances*. The resistance which is offered to motion is called friction. Force can be measured. *Parallelogram* and *equilibrium* of forces should be explained; also *centrifugal* and *centripetal* forces should be exemplified. The

force in virtue of which unsupported bodies fall from a height to the earth is called *gravity*. The earth attracts every body towards its centre. The force of gravity determines the weight of a body. Every body has a centre of gravity; the force of earth's gravity exerts on the centre of the body. Instances should be given to understand this. Whenever the centre of gravity of a body rests upon any support, the action of gravity is counter-balanced, and therefore the body remains in *equilibrium*. Examples of a toy heavy at its bottom, rope dancing, walking on stilts, leaning towers, ordinary balance, pendulum, steelyard, etc.

Falling bodies generate a force in descending. Men have utilized this force in the working of clocks by means of pendulums.

Cohesion is the force which unites two molecules of the same nature; for example, two molecules of water or two molecules of iron.

Chemical affinity or *chemical attraction* is the force which is exerted between molecules of not of the same kind. In water, oxygen and hydrogen have affinity for each other.

Adhesion is the attraction between two bodies when their surfaces are placed in contact.

Capillary phenomena. When solid bodies are placed in contact with liquids, molecular attraction gives rise to capillary phenomena.

Absorption and *imbibition* are the penetration of a liquid or a gas into a porous body.

Tenacity. Besides the general properties of solids, liquids and gases, there are some other properties special to solids. They are *tenacity*, *hardness*, *ductility* and *malleability*. *Tenacity* is the

resistance which bodies oppose to being broken when exposed to traction or stretching. *Hardness* is the resistance which bodies offer to being scratched by others. *Ductility* is the property owing to which a great number of bodies change their forms by the action of stretching or pressure. *Malleability* is that modification of ductility which is exhibited when metals are hammered.

Liquids

One essential character of a liquid is the *extreme mobility* of its molecules, which are displaced by the slightest force.

Equality of pressures.—Pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions, and acts at right angles to surfaces exposed to the liquid. On the basis of this law, *hydraulic press* was invented, by which enormous pressure may be produced.

Level of liquids.—A liquid is said to be *level* when all the points of the surface are in the same horizontal plane. On account of this law, we have water level, spirit level; streams, springs, wells, artesian wells are working; big cities have water-works by the erection of big water-tanks at a great height over the level of the cities.

Principle of Archimedes.—A body immersed in a liquid loses a part of its weight equal to the weight of the displaced liquid. Human body is lighter, on the whole, than an equal volume of water; it consequently floats on the surface, and still better in sea-water. In man the head is heavier than the lower parts, and consequently tends to sink; and hence swimming is not natural to

him, but is an art which requires to be learned. Quadrupeds, on the contrary, easily keep the head, which is less heavy than the hinder part of the body, above water; and these animals, therefore, swim naturally.

If a person who cannot swim, and falls into water, could retain sufficient coolness to turn on his back, so that his face is out of water, he could breathe freely, and wait until help arrives. Weight for weight, fat persons float more easily than lean ones, for they displace more water.

Several kinds of birds, such as ducks, geese and swans, swim easily upon water, because they have a thick coating of a light down, impervious to water, which covers the lower part of the body, so that even with a small immersion they displace a weight equal to their own.

Swimming bladder of fishes.—Most fishes have an air bladder below the spine. The fish can compress or dilate this at pleasure by means of a muscular effort, and thus rise or sink in water.

Specific Gravity of a substance is the weight of any volume of it compared with the weight of the same volume of distilled water at 4°C.

Specific Gravities of Solids

Platinum	22	Diamond	3·5
Gold	19	Aluminium	2·7
Lead	11	Glass	2·5
Silver	10	Salt	2·0
Copper	9	Coal	1·3
Iron	8	Ice at 0°C	0·9
Zinc	7	Cork	·2

Specific Gravities of Liquids

Mercury	13·60	Olive oil	0·9
Milk	1·03	Liquid oxygen	0·9
Seawater	1·02	Absolute alcohol	0·8
Distilled water	1·00	Ether	0·7

Hydrometers are made to measure densities of pure water or sea-water, etc., alcohol, urine, milk, acids, etc.

Water.—The most common liquid is *water.* It is composed of 2 parts of hydrogen and 1 part of oxygen by volume, by weight 1 part hydrogen +8 parts oxygen.

It is one of the most useful substances. The various uses of it are too numerous to be enumerated. Important Physical Properties:— (a) It is a transparent liquid with no taste or smell. (b) In large thick layers it presents a faint bluish tint. (c) Its specific gravity is 1. (d) It is volatile, it gives off vapour at all temperatures. (e) It is able to transfer motion which it has acquired (as observed in river current, waterfall, pump, syringe, hydraulic press, etc.) (f) It has slippery cohesiveness. (g) It has a specific heat of 1. (h) Unlike solids water presses in all directions. (i) It is a bad conductor of heat. (j) Its mean temperature is 62°F; above 210°F it boils away into steam and at 32°F it becomes ice. (k) Ice is lighter than water; and therefore floats over water; $\frac{1}{8}$th of the volume of ice remains above water. (l) It dissolves some solids, such as, sugar, salt, etc., and also some gases, as nitrogen, carbonic acid gas. (m) When it is changed into steam, its volume becomes about 1700 times greater. (n) Water is almost incom-

pressible;—if a hollow iron shell (which is quite full of water) is served down or tightened at its boles, be kept in ice, water will burst the iron shell. (o) Water seeks its own level; as in a U-shaped tube; fountains act on this principle. (p) Steam of water is an elastic fluid.

Important Chemical Properties:—

(a) Water is neutral, i. e., it is neither alkaline nor acidic. (b) When water is mixed with sulphuric acid, heat is developed, and the temperature rises. Metals such as potassium or sodium decompose water at ordinary temperatures. Magnesium decomposes it at a higher temperature. Steam is decomposed hy red hot iron. (c) By means of passing electric currents in water, it can be decomposed into two gases, hydrogen 2 volumes, and oxygen 1 volume. The process is called electrolysing. By a different method of applying electric currents, these two gases can be combined into water. (d) Watery vapour is mixed with air; it serves for the nourishment of both animal and vegetable life. (e) Water may be spoken of as *hard* or *soft* according to its behaviour with soap. Water which when used with soap does not give lather or foam, unless much soap has been spent, is known as 'hard water'. Water which with very little soap readily gives a large amount of lather is known as 'soft water'. Our body contains 60 per cent of water. Without it there can be no salivation, digestion, cerculation of blood, and elimination of poisonous matter. Most of the diseases can be cured by water.

Gases

Gases are called *elastic fluids*. The atmosphere in which we live, i.e., common air mainly consists of two gases, (1) Oxygen 1 part and (2) Nitrogen 4 parts,—they are not chemically combined, but are mixed. There are two more important gases, which are mixed in very small proportions. (3) Watery vapour, which varies from 4 to 6 grains in a cubic foot of air with the temperature, the season, the locality, etc., and (4) carbonic acid gas (carbon dioxide) from 3 to 6 parts in 10,000 cubic feet.

Air.— 1. Every living animal takes in oxygen and expels carbon dioxide with the breath. Plants require carbon dioxide from the air, because it is their food. The green colouring matter of the plants decomposes it in the presence of sunlight, liberating oxygen which escapes into the atmosphere. The carbon is used up by the plants in building up their tissues and substances, which ultimately serve for the food of the animals. 2. Water vapour serves for the nourishment of both animal and vegetable life; it is due to water vapour present in air that clouds are formed and rain falls. 3. The air is not a chemical compound of the two gases, oxygen and nitrogen. 4. The pressure of atmosphere is 14·73 lb. per square inch in all directions. The human body sustains a pressure of several tons from inside and outside. As the pressure exerted at each point or particle of the body is very little, we do not feel any sensation of the pressure. 5. *Barometer* is a weather-indicator. The rise and fall of mercury in

the instrument predicts changes of weight or pressure of the atmosphere. As the atmosphere is in constant motion, its pressure at the same spot undergoes changes, and these are indicated by corresponding changes in the weight of the mercurry of the barometer. 6. Extent of the atmosphere.— The density of the air diminishes as the distance from the sea level increases. At a height of 10 miles man cannot breathe, and the temperature is so low that it becomes unbearable. The height at which the air still possesses sensible density is calculated to be from 40 to 45 miles. If the air were of the same density throughout as at sea-level, it would only reach to a height of rather more than 5 miles above the level of the sea. 7. Temperature of the Air.— Like its density, the temperature of the air varies greatly at different places, and at different heights over the same place. It diminishes everywhere as we ascend into higher regions, and at last we come to a point where the temperature never rises above the freezing point. This is called the line of perpetual snow. Under the equator this line is not reached until we rise about 15,000 feet, whilst in the latitude of 75° it comes down to the sea-level. The atmosphere acts not only as a powerful modifier of the sun's heat, but also an equally powerful retainer and distributor of that heat. Were it not the presence of the air, the earth's surface would be scorched by day and frozen by night. 8. *Ozone.*— Air contains a very small percentage of a gas called ozone. Ozone (formula O_3) contains nothing but *Oxygen* and is decomposed by heat. It has a peculiarly characteristic smell (resembling

very dilute chlorine). It can be condensed to a blue liquid, and is very powerful oxidising agent.

The pressure of atmosphere about 15 lb. per square inch can be experimented by means of an air-pump and rubber bladder, 2 metallic hemispheres, or by placing palm over a vacuum glass tube. *Barometers* of different kinds show the pressure of atmosphere. This instrument predicts the coming of a storm, and is, therefore, indispensable in a ship.

Barometer determines the heights of places above the sea-level. Heights of mountains are measured by barometer.

Water and many other liquids possess the property of absorbing gases.

Air-pump.—A great many experiments with the air-pump have been made;— mercurial rain, fall of bodies in vacuo, the bursting of a bladder, test of atmospheric pressure by two hemispheres, etc.

Application of the vacuum to the preservation of food.—In vacuum foods can be kept fresh for years.

Condensing-pump is an apparatus for condensing air or any other gas. Torpedoes used in naval warfare are propelled by means of compressed air. So is airgun.

By means of *Suction-pumps* water can be raised to 20 to 25 feet. In *Force-pump* water is not raised by the pressure of the atmosphere, but by the pressure of the piston on the water during descent. *Fire-engine* is an application of force-pump, by which water has been forced to a great height in a continuous stream.

The syphon, intermittent springs, are instances showing pressure of air. In *Diving-bell* fresh air is supplied by a compression pump.

Air-baloons are filled with heated air, with hydrogen gas, or with coal gas. *Parachute* by resisting the air, checks the rapidity of the descent of the aeronaut. The present-day *Aeroplanes* fly in the air by means of paddles worked with great force.

Sound

Acoustics, or the scientific study of sound, is concerned with the questions of the production, transmission, comparison and perception of sounds. *Music* considers sounds with reference to the pleasurable feelings which they are calculated to excite in us. As air is very mobile, compressible and elastic, its molecules, being in contact with different parts of the sounding body, acquire movements; and communicate them to the *tympanum* or *drum* of the ear. Sound is not propagated in a vacuum. This can be proved by striking a bell in vacuum-globe. The medium of sound is usually the air, but all gases, vapours, liquids and solids also transmit sound. This can be easily shown by using a *string telephone.*

Reflection of sound can be perceived by placing 2 parabolic mirrors placed at some distance opposite each other. *Refraction of sound* can be perceived by proper instrument.

Echoes and resonance. In certain buildings an echo repeats 20 or 30 times. *Sound is strengthened by the neighbourhood* of a resonant body. *Speaking trumpet* is used to render the voice audible at a great distance. A strong man's voice sent through

a trumpet 20 feet in length has been heard at a distance of 3 miles, while without such help 1000 feet is the greatest distance.

Ear-trumpet or *audiphone.*—The ear-trumpet is used by persons who are hard of hearing.

Musical Sounds.—Musical sound produces a continuous or regular sensation; while noise is jarring to the ear. Musical sounds or tones have three leading qualities,—(1) pitch, (2) intensity, and (3) timber, colour or quality. (1) *Pitch* or *frequency* of a musical tone is determined by the number of vibrations in a second yielded by the body producing the tone. (2) The *intensity* or *loudness* of the tone depends on the *extent* or *amplitude* of the vibrations. (3) The *timber* is that peculiar quality of tone which distinguishes a note when sounded on one instrument from the same note when sounded on another.

Human ear can perceive 48000 vibrations in a second. Sounds used in music, and more especially in singing, are comprised within much narrower limits.

In music 7 musical notes or sounds have been recognized; they are called *saptaka* in Indian music; octave in English music (with higher c note).

Names and proportions, and number of vibrations of these Notes.

C	D	E	F	G	A	B	C	Greek symbols
do	ri	mi	fa	sol	la	si	*do*	English names
सा	री	ग	म	प	ध	नि	सा	Indian names
1	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	2	Proportion of vibrations
66	74	82	88	99	110	122	132	No. of vibrations.

A Tuning Fork is an instrument yielding a constant note, and is used as a standard for tuning musical instruments.

The practical range of musical sound is comprised between 40 and about 4,000 vibrations in a second, or within 7 octaves.

Visual Figures by Sound Vibrations.—It is found by experiments by passing a violin-bow smartly along the edge of a thin metal plate clamped on a rod and previously strewn over with very fine sand, that different notes arrange the sand particles in beautiful and characteristic figures.

Musical instruments are generally divided into 3 broad classes:—(1) instruments of percussion, such as, *dholak*, drum, bell, gong, etc.; (2) stringed instruments, such as, violin, *sitár*, *sárangi*, *esráj*, etc.; (3) wind-instruments, such as, *bansi*, flute, bag-pipe, clarionet, etc.

Heat

Heat is not a substance, but *a condition of matter*, and a condition which can be transferred from one body to another. Heat *is a form of energy* and it may be converted into energy of motion. All bodies expand by the action of heat. As a general rule gases are the most expansible, then liquids and lastly solids. Heat somewhat softens bodies.

Thermometers are instruments for measuring temperature. Mercury or alcohol are put in thermometers. Two kinds of Thermometers are generally used, one is *Centigrade* (divided into 100 parts); and the other is Fahrenheit (divided into 212 parts). The Clinical Thermometer

records from 95° to 110° in Fahrenheit readings. It measures blood-heat. The normal temperature of man is 98·4°. The use of it should be explained to students.

Applications of the expansion of solids are exemplified by leaving a small space between successive rails of railways; heated glass is not cooled too rapidly nor a cold glass is heated too rapidly,—if so done they will crack.

Crystallisation.—When bodies pass slowly from the liquid to the solid state, their molecules generally acquire a regular order and arrangement. They assume the geometrical shapes of cubes, pyramids, prisms, etc., which are perfectly definite, and are known as *crystals*. Flakes of snow, ice in the process of formation, sugar candy, alum, common salt, and many other substances, are crystallised.

Freezing mixtures are frequently used in chemistry, in physics and in domestic economy.

Evaporation of liquids is caused by open air, sun's rays, high temperature, reduction of pressure, etc.

Liquefaction or *condensation* of vapours is generally caused by cooling, compression, or chemical affinity.

Distillation in *stills* is an operation by which a liquid is converted into vapour by the action of heat and then the vapour is condensed by cooling. Water is purified by this process; and alcohol is extracted.

Steam Engine is the most important appliance for utilizing very great elastic force of watery vapour in driving railway carriages and in doing a

lot of work in workshops and manufactories.

Horse-power.—In England one horse-power (a conventional unit of force) represents a power which can raise 33,000 lb. to one foot per minute.

Sources of Heat are 1st *mechanical sources,* comprising friction, percussion and pressure; 2nd *physical sources* are solar radiation, terrestrial heat, molecular actions, changes of condition and electricity; 3rd the *chemical sources,* or molecular vibrations, or more especially combustion. The solar heat is very great; if one year's solar heat be collected it can melt 35 ft. thick layer of ice all round the earth.

Meteorology

(*Meteorological Phenomena depending upon heat*)

Meteorology is that branch of physics which is concerned with the phenomena which occur in the atmosphere,—such as, for instance, variations in the temperature and pressure of the air, wind, rain, storms, electric phenomena, etc.

Mean temperature.—*Daily mean temperature* is that obtained by adding together 24 hourly observations and dividing by 24. Similarly monthly mean temperature is calculated by dividing the total of 30 days by 30; and the temperature of a year is the mean of those 12 months. The temperature of a place is the mean of its annual temperature for a great series of years.

Causes which modify the temperature of the air are the latitude of a place, its height above sea-level, the direction of the wind, and the proximity of seas. At the equator the sun's rays fall vertically; as we come nearer the poles, the sun's

rays fall slantingly, therefore, the heat absorbed decreases from the equator to the poles. Yet, as in summer, the days are longer as we get nearer the poles, the loss due to the increasing obliquity of the sun is partially compensated by the sun remaining longer above the horizon.

The *height* of a place above the sea-level has a much more considerable influence on the temperature than its latitude. The cooling as we ascend in the atmosphere has been observed in balloon ascents, and a further proof of it is seen in the perpetual snows which cover high mountains, even in the torrid zone. The height at which snow remains unmelted throughout the year, which is known as the *snow line* or *line of perpetual snow,* differs in different places. On the Andes it commences at a height of 14,760 feet, on the Alps at 8,880 feet, and in Iceland at 3,070 feet.

Direction of winds.—As winds share the temperature of the countries which they have traversed, their direction exercises great influence on the temperature in any place.

Proximity of sea.—The neighbourhood of the sea tends to render the temperature of the air uniform, by warming it in winter and cooling it in summer.

Gulf Stream.—A similar influence to that of the winds is exerted by currents of warm water.

Climate.—By the *climate* of a place are understood the whole of meteorological conditions to which a place is subjected.

Fogs and mists.—When aqueous vapour diffuses in the cooler air, it is condensed.

Clouds are masses of vapour condensed into

water particles of extreme minuteness, like fogs and mists, from which they differ only in occupying the higher regions of the atmosphere. They have been divided into 4 principal kinds,—the *nimbus*, the *stratus*, the *cumulus*, and the *cirrus*; you can distinguish them by seeing their photographs. The height of *cirrus* is about 27,000 feet; the height of *cumulus* is 4000 to 5000 feet; the height of *stratus* is about 2040 feet. The *nimbus* are rain clouds.

Rain.—When individual vapour particles become larger and heavier by the constant condensation of aqueous vapour, and finally when individual particles unite, they form regular drops, which fall as *rain*.

Rain-gauge measures rainfall. At London the annual rainfall is 23·5 inches and at Calcutta 62·5 inches. The heaviest annual rainfall at any place on the globe is on the Khasi Hills in Bengal, where it is 600 inches.

Dew; hoar-frost.—Dew is aqueous vapour condensed on bodies during the night in the form of minute globules. *Hoar-frost* is nothing more than dew which has been deposited on bodies cooled below zero, and has, therefore, become frozen.

Snow is solidified in crystals variously modified, and floating in the atmosphere. These crystals are more regular when formed in a calm atmosphere. They exhibit exquisite regularity and at the same time beautiful variety of forms. One foot of snow is equal to one inch of rain.

Sleet is also solidified water, and consists of small icy needles aggregated together in a confused manner.

Hail consists of masses of compact ice of different sizes, which fall in the atmosphere. *Hailstones* fall from the size of small peas to that of a sphere 2 inches in diameter.

Winds are currents moving in the atmosphere with variable directions and velocities. *Anemometer* is an instrument to determine the direction and velocity of wind. With a velocity of 6 or 7 feet per second, the wind is moderate, with 30 or 35 feet, it is fresh, with 60 to 70 feet it is strong, with 85 to 90 feet it is a tempest, and from 90 to 120 feet it is a hurricane. *Winds* are regular, periodic, or variable. Necessary particulars of *tradewinds, monsoon, sirocco, land and sea breezes, typhoon,* etc. should be taught from physical geography.

Light

Light is the agent which, by its action on the retina, excites in us the sensation of vision. That part of Physics which deals with the properties of light is known as *Optics*.

Various sources of light are sun, stars, heat, chemical combination, phosphorescence, electricity and meteoric phenomenon. The velocity of light is 190,000 miles per second.

Kaleidoscope is a very simple arrangement by which small irregular pieces of coloured glass are placed at one end between 3 glass mirrors placed in the form of a prism. Beautiful endless symmetrical forms are seen through the tube.

Images are seen quite different in spherical, concave, and convex mirrors: some of the images are amusingly distorted.

Heriograph is an apparatus having a mirror about 4″ in diameter mounted on an adjustable tripod, so that sun's light can be received on it, and reflected to a distant station upto 40 miles. It is very serviceable in wars in signalling at the rate of 12 words a minute, where the sun's light is available.

Refraction of Light.—When a pencil of light passes more or less obliquely from one transparent medium into another—for instance, from air into water, or from air into glass— it undergoes a deflection from the straight line in which it proceeds. This change in direction is called *Refraction*.

Various effects of refraction are:—(1) We do not see fish in the place they actually occupy, but a little higher. (2) Similarly, we see the bottom of a clear river or pond higher than it really is— water that appears to be 3 feet deep is in reality 4 feet deep. (3) The air renders the sun visible when it is in fact below the horizon, because the lower layer of atmosphere is always thicker than higher layer. (4) *Mirage* is an optical illusion by which inverted images of distant objects are seen as if below the ground, or sometimes as if in the atmosphere. This phenomenon is of most frequent occurrence in hot climates, and more especially in the sandy plains of Egypt. The ground there has often the aspect of a tranquil lake on which are reflected trees and the surrounding villages. (5) Mariners sometimes see in the air images of the shores, or of distant vessels. (6) On account of various densities of atmosphere and their constant changes and continual motion, *fata morgana* are often seen at Naples and on the coast of Sicily;—

it is a fairy-like phenomenon. There are suddenly seen in the air at a great distance ruins, columns, palaces, castles, etc. (7) *Prisms* produce remarkable effect upon light which traverses them. First, a *deviation*, and secondly, a *decomposition* into various coloured lights.

Different kinds of lenses.—In optics 6 kinds of lenses play very important part in converging or diverging rays of light. The 6 kinds are: double-convex, double-concave, plano-convex, plano-concave, and the remaining two kinds are like *crescent-shaped moon.* Different kinds of lens are utilized in making spectacles, binoculars, microscopes, telescopes, stereoscopes, photographic camera, magic lanterns, cinemas, phantasmagoria, ghost-scenes, light-houses, searchlights, etc.

Solar Spectrum.—By means of a *prism* the white rays of the sun can be decomposed into several kinds of light of 7 different colours, *violet, indigo, blue, green, yellow, orange* and *red*. The 7 colours of the spectrum are simple or primitive colours. Newton was the first to decompose white light by prism, and to recompose it by various experiments. Our eyes are fitted with double convex crystalline condensing lens, retina (the screen), transparent vitreous humour, transparent aqueous humour, pupil (an aperture), etc. The eye is, in fact, a small *camera obscura.*

Rainbow is a grand luminous phenomenon which appears in the sky opposite the sun when rain is falling. It contains seven concentric arcs, presenting successively the colours of the solar spectrum.

Magnetism

Natural and artificial magnets.—Natural magnet, or *lodestone,* is a mineral which has the property of attracting iron and a few other metals. This mineral is an oxide of iron. A rodlike piece of lodestone when dipped into iron filings attracts them at opposite ends or edges. This lodestone or magnetic stone was known to the ancient Greeks.

Artificial magnets are usually made of steel. When steel is hardened by being raised to a high temperature, and suddenly cooled by immersion in cold water, it acquires great hardness and may be converted into an artificial magnet. The magnetic property is imparted to it by rubbing it with a powerful magnet either natural or artificial in a particular way; and it then becomes a permanent magnet itself. Artificial magnets have just the same properties as natural magnets, and are far more convenient and powerful. They are sometimes made into bars; a foot or two long; sometimes in a horse-shoe form; or, lastly, if they are made free to move, they are cut out of a thin sheet of steel pointed at two ends and with a small hole in the middle, so that they can rest on a needle-like vertical pivot and oscillate freely in a horizontal plane. Thus arranged, the artificial magnet becomes a *magnetic needle* or a *compass needle.* The two ends of a magnetic bar, called the two poles of the magnet, attract iron most powerfully; at the middle there is no attraction, it is called neutral line. The two poles are called *positive* and *negative* poles, (or sometimes *north* and *south* poles), respectively. In reference to

magnetic attraction and repulsion, the following law may be enunciated:—Poles of the same name repel, and poles of contrary names attract, each other. This can be easily seen by using one freely moving magnetic needle and a magnetic rod. The attraction which a magnet exerts upon iron is a reciprocal one,—that is, iron attracts magnet with the same force as magnet attracts iron, if the iron be bigger than the magnet, the magnet will move towards the iron. When a magnetised rod of equal thickness is cut at the neutral line, each of the two rods will act as a magnet. A magnet creates a *magnetic field* of attraction, the strength of which at any point of the field can be determined by the strength of the magnet and the distance and direction of the point from the magnet.

Mariner's Compass is the most important application of the magnetic action of the earth. It guides the course of a ship. *Prismatic Compass* is used in surveying; it differs from the mariner's compass mainly in its dimensions, and in the way in which observations are made.

XXII

ELECTRICITY

Nature of Electricity.— As yet the exact nature of electricity has not been determined. The scientists have discovered that electricity pervades all space, even in vacuum, and it exists in every particle of matter,—solid, liquid or gas. It cannot be perceived by any of our five senses;—it has no

property of any solid, liquid or gas; in fact, it is unlike any matter known as yet. But it manifests itself mainly through a medium of matter, by attraction and repulsion, also by its chemical, thermal and luminous effects. All substances are composed of electricity, which is of two kinds, positive and negative. Normally these are present in equal amounts, and the body is neutral.

Negative electricity is very fluid or mobile compared with positive. They are known as *electrons*. Positive electricity is also composed of ultimate particles, exactly the same in all bodies and to these the name *protons* has been given. Proton is far heavier, by some 1840 times than electron. One pound of any sort of matter contains 548,000,000,000,000,000,000,000,000 particles, of which one-half is protons, the other half electrons. The simplest atom, that of hydrogen, contains only one proton and one electron; the electron revolves round the proton many millions of times per second.—*Wonder Book of Electricity*, p. 13, 14.

Electricity in motion is called *electric current*. It requires a definite path through which it must flow, if it is required to work. Metals are generally the conductors of electricity;—silver, copper, aluminium are considered the best conductors. But copper being cheaper and stronger than silver or aluminium, it is universally used for the flow of the current.

Electricity is the basic foundation of the construction of all the chemical elements and their compounds, whether they be solid, liquid or gaseous. The difference of one element from another lies in the number of electrically charged particles

called electrons arranged around a positive charge called proton. By re-arranging these electrons, or by reducing or increasing their number in an atom, by the aid of suitable electric or other force, the transmutation of one element to another element has been accomplished,—for example, hydrogen has been transformed to potassium.

Conductors and Insulators.—The electric current can circulate freely on the surface of certain bodies which are called Conductors, but other bodies which do not allow the current to flow through them readily are called Insulators. As men are conductors, they should not touch or handle live electric wires, fittings or machines without sufficient protection,—(a) by disconnecting the current, or (b) by standing on non-conducting wooden frame or (c) by wearing rubber, silken, paper gloves or other suitable insulating protectors.

Conductors	*Insulators*
Metals	Air and dry gases
Acids	Dry paper
Moist articles	Silk
Vegetables	Indian rubber
Animals	Glass
Electrolytes	Sulphur
	Resins

Generation of Electric Power.—Coal is first burnt in a furnace, liberating heat-energy; this heat is used to raise steam in a boiler which drives turbine producing mechanical energy, and the turbine drives an electric generator giving electric energy. Although coal is generally used in the power stations, crude oil or petrol is used as sour-

ces of power. A flow of river-water or waterfall works water-wheels or turbines, to which electric generators are coupled. Steam turbines, steam-engines, oil-engines as well as gas-engines are equally utilized to generate electricity on a commercial scale. The electricity thus generated can be stored up in the form of chemical energy in what are called accumulators, and the energy so stored can be conveniently used in such places where there is no arrangement of generating it.

Definitions of some Common Electric Terms

In order to get some idea of electricity and its workings, the following definitions are necessary:

Accumulator.—An electric cell which stores and which supplies electric current.

Alternating Current (A.C.).—An electric current which alternately reverses or changes its direction of flow in a circuit.

Amp. (Ampere).—The unit of current. If an ampere passes for one second, one current flow is registered.

Armature.—That part of the electric motor or dynamo that is free to rotate when acted on by the magnetic field. It comprises a winding on an iron core.

Battery.—Two or more cells or accumulators connected together to give an increased electric current or voltage.

Circuit.—Number of conductors specially arranged for the purpose of carrying an electric current.

Conductor.—A substance, generally made of metal, which is used to carry an electric current,

and which offers a low resistance to its passage.

Direct Current (D.C.).—An electric current which flows in one direction only.

Dynamo.—An electro-magnetic machine used for producing electric current from mechanical energy or power.

Electron.—The smallest unit of negative electricity. Six-trillion electrons are equal to one ampere (electric unit).

Ether.—A medium pervading all space, which is capable of being set in motion (thus setting up "ether waves") by electro-magnetic energy.

Field.—That part of a dynamo or motor (usually fixed) which produces the electro-magnetic field that acts on the armature. This action causes the armature to rotate (in case of a motor), or generates an electric current (in the case of the dynamo).

Filament.—A thread like conductor, usually of tungsten, which becomes incandescent (and emits light) when an electric current passes through it. Glass bulbs contain such filaments.

Fuse (or Cut out).—An apparatus designed to protect an electric circuit by the fusing or melting of a metal wire or strip in the event of a large or dangerous flow of current in the circuit.

Galvanometer.—An instrument for indicating very minute currents.

Generator.—An electro-magnetic machine for producing an electric current.

Insulator.—A material which offers a high resistance to the passage of electricity.

Ion.—One or a number of atoms joined together and charged with positive or negative electricity.

Kilowatt.—Kilo (a Greek word) means 1000;—one thousand watts.

Magnetic Field.—The space surrounding a magnetic body or conductor carrying current and throughout which magnetic forces act.

Motor.—A machine used to convert electrical power to mechanical power.

Negative.—The terminal or pole of a direct current generator or battery to which the current returns from the external circuit.

Ohm.—The unit of resistance, i.e., of that property in an electric conductor which tends to impede, or oppose the flow of a current.

Positive.—The terminal or pole of a direct current generator or battery from which the current commences to flow through the external circuit.

Switch.—An apparatus designed readily to open or close an electric circuit.

Unit.—An unit represents a thousand watts (kilowatts) flowing for a period of one hour. An ampere is the practical unit of electric current.

Volt.—Unit of pressure. E. M. F. (Electromotive Force) is the property that *pushes* the current through the electric circuit.

Watt.—The unit of electric power, or rate of working, being the product of the pressure (volts) multiplied by the current (amperes). Voltmeter measures the pressure of an electric circuit.

Physiological effects of electricity consist of a violent excitement which electricity exerts on the sensibility and contractibility of the organic tissues through which it passes; and, in the latter, of violent convulsions which resemble a return to life.

Formation of Ozone.—When an electric ma-

chine is at work, *ozone* is formed in the atmosphere. Ozone can be recognized by its peculiar odour and by its chemical properties.

Thunder and lightning are the effects of electricity. Even in cloudless atmosphere positive electricity of the atmosphere is greatest in the highest and most isolated places. It is also perceptible in large open spaces at a certain height above the ground. Meteorologists have mentioned four kinds of lightning according to their shapes,—stream, sinuous, ramified and meandering. Lightning is visible at a distance of more than 100 miles, while thunder is not heard at a greater distance than 17 miles. Very small number of persons are killed by lightning. It was calculated that in France only 20 persons are killed by lightning—one victim for two million inhabitants. Many more persons die by railway accidents.

Lightning-conductor.—It is a metallic rod attached to the side of a building, its upper end being carried above the highest point of the roof, and its lower end embedded in the ground. It is mostly made of iron or copper, in the form of a rod or stranded wire or flat band.

Aurora borialis is a remarkable luminous phenomenon which is frequently seen in the atmosphere at the two terrestrial holes, but more specially at the North Pole. At the close of the day an indistinct light appears on the horizon. This luminosity gradually changes into a regular arc of a pale yellow, with its concave side turned towards the earth. Finally, the rays burst over the horizon, passing successively from yellow

to deep green, and to the most brilliant purple. The luminous arc often remains visible for some hours; then the lustre diminishes, the colours disappear, and this brilliant phenomenon gradually vanishes, or is suddenly extinguished. It is nature's greatest and most awe-inspiring sky-display. There are many variations of the aurora;—arcs, bands, curtains, rays, coronas, draperies, etc. It defies camera on account of its continual movement.

Electricity by chemical action.—All cases of chemical action are accompanied by a disturbance of the electric equilibrium. All chemical actions between metals and liquids are the most productive of electricity.

An Electric Battery is a collection of cells, primary or secondary, used for the production or storage of the power, in small lighting sets, wireless receivers, etc. *Cell* is a single jar or unit used for interchanging chemical or electrical energy. *Accumulator*, otherwise known as a storage battery or secondary cell, in its simplest form consists of a vessel (usually glass) containing a number of lead-plates coated with red-lead or litharge and placed in dilute sulphuric acid. The cell or series of cells is then charged with an electric current.

Frictional Electricity.—Whenever two bodies are rubbed together, the two kinds of electricity (positive and negative) are developed at the same time and in equal quantities—one body develops the positive and the other the negative electricity. When a body is electrified, all the electricity goes to the surface, where it is accumulated as an extremely thin layer, tending con-

stantly to escape, and flying off, in short, when it is not retained by any obstacle.

Electric Recreations.—By taking advantage of the law of electric attraction and repulsion, several interesting experiments can be shown to the students in order to interest them in the study of the science of electricity, such as, (1) Electric *whirl* or *vane*. (2) Electric *orery*. (3) Electric *egg*. (4) Luminous globe and tube. (5) *Volta's cannon*. (6) Gyroscope. (7) Magic toys. (8) Magic fish. (9) Passing of electric current through different gases, etc.

Dry Cells Battery.—Owing to the want of portability of cells containing liquid electrolyte, cells in which the electrolyte is in the form of a paste are available in the market, and they are called dry cells. The term 'dry cells', however, is really a misnomer, for no cell can furnish current for more than a minute if it is dry. The name is, however, universally used to designate a class of cells which are relatively dry as compared with the cells having liquid electrolyte. Electrolyte means a liquid or gaseous conductor that undergoes a chemical change when an electric current is passed through it. In addition to portability, dry cells have the further advantage that they require no attention during working such as the addition of water, that they are generally unbreakable and may be used in any position. They are used for flash lights, electric toys, experimental purposes, curing ailments, etc.

Uses of Electricity

Nowadays men are deriving great benefit by the use of electricity in multifarious ways. It would

take 100 to 200 pages to describe the appliances by means of which electric power is utilised. Heads of the education department would do well to publish a popular interesting book on the subject. Here I can only mention some of the uses. School-boys should be entertained by the playing of electric toys.

(1) "There is an insatiable demand for electrical service. Gigantic in its day, the station at Niagra Falls, where the inexhaustible resources of the world-famous waterfall are tapped, pales before the stupendous engineering feat lately completed at the Boulder Dam, Colorado, U.S.A. Here the Colorado River is being harnessed to drive such gigantic turbine generators that their initial power will be 2,000,000 horse-power, i.e. roughly 1,500,000 kilowatts, which is four times the power generated at Niagra. In this Colorado scheme, the water in the turbine tunnels falls nearly 475 feet. When it reaches the turbines, it has a speed of 120 miles an hour."—"*The World's Wonders Illustrated*", p. 359.

(2) Electricity in Industry and Commerce.—Machines of workshops are worked by electricity. Labours have been lightened and tasks otherwise impossible are now performed with ease. Without electricity distant communications and despatch of raw and finished goods could not be made with ease and cheapness.

(3) On the ocean.—The sailing ship has been almost forgotten. Now oil-fired furnaces provide the steam for driving the turbines; in the turbo-electric vessel the turbines give motion to those mighty generators whose energy drives powerful electric

motors that propel the ship through the water. Instead of former magnetic compass with the errors and ever-changing deviations, now electrically driven gyroscopic compass with its steadfast undeviating North point is used. Formerly, the sailor had to ascertain the true position of the ship in the midst of ocean by means of uncertain readings of optical sextant. Now the wireless direction finding apparatus in a minute can fix the exact position.

(4) Vast quantities of hardest steel are melted on the electric furnace. Hardest metals some inches thick are sheared off into pieces by electric machines by annealing them in annealing furnaces.

(5) Light works are made by electric machines, for example, cigarettes are weighed, rolled, gummed, and counted into packets.

(6) Although motor-cars are propelled by petrol, an electric tiny spark from induction-coil or magneto ignites the petrol vapour.

(7) Copper and aluminium are purified almost 100 p.c. by electrolysis, with currents of hundreds of thousands of amperes. Electro-chemistry has many modern industrial applications as in production of metals (aluminium, sodium, iron alloys, etc.) and in the manufacture of nitrates, and other synthetic fertile fertilisers, calcium carbide, phosphorus, etc.

(8) Telegraphic messages were sent by manual Morse system, but now automatic sender and receiver are working ten times faster than manual operation. "We now have the automatic sender giving place to the tele-printer, by means of which a typist at one end of a line, or wireless link, can

type out a message that will thereby be immediately typed out by a similar machine at the other end."

(9) Extraordinary Telephone Exchanges.—In big cities ordinary telephone exchanges are made. "Even the transatlantic cables are becoming too slow for the modern businessman. He now calls up his telephone exchange and asks for the number he requires in any other country.** His voice is flashed across oceans and deserts and jungles by the wireless beam links that span the world."

(10) In big factories and commercial organizations, electrically operated adding machines are used and most intricate problems are solved with a speed and accuracy quite impossible by human agency.

(11) The Magic of X-rays.—Industry, commerce, the science of healing, as well as purely scientific investigation use X-rays. Welding of boilers, ships, water-tanks and the like are examined by X-rays. Custom officers easily detect smuggled goods without opening boxes. Scientists use them in chemical analysis. Fractures, improper growths and internal maladjustments are revealed.

(12) Electric heaters warm the cold rooms in winter without dust, fume or smell.

(13) Incandescent wires can cook our food kept in tight cookers nicely with steady heat in a measured time, fixed by experience for different dishes. Water can be heated to required temperature.

(14) Laundry work can be done smoothly with automatic heat-control.

(15) By the use of proper appliances, we can produce steady electric lights of little or enormous power and can change their colour at will.

(16) In a large poultry-house, electric lighting and warming equipment are a necessity. In winter hens go off laying. On account of artificial light and warmth, hens live healthier and produce extra modicum of eggs.

(17) In modern dairy electric equipment is a necessity for pasteurization by heating and sudden cooling in an electric heater and electrically driven refrigerators, for milking large herds of cows, and for making butter and cheese.

(18) In order to give early vegetable crops, farmers heat the soil and the air of glass-houses by electricity.

(19) Electric trains are more speedy, comfortable and reliable than those worked by steam-engines. Electric trams, buses, trolleys, vehicles for refuse collection, milk and bread supply, carry millions of persons and tons of goods. The underground electric railways of London are successfully working for years. It is expected that gradually steam-trains will be replaced by electric trains.

(20) "Electro-therapy is application of electricity to treatment of diseases. Direct and high frequency alternating current and static discharges of suitable strength are used. The results include benefit to the nervous system, the creation of heat at greater depths than can be reached by external application, and the destruction of certain growths."

(21) Electroplating is a process by which a thin layer of one metal is deposited electrolytical-

ly upon another metallic surface. The metal to be deposited may be gold, silver, nickel, copper, etc. Silver-plating is widely adopted for many articles of brass and copper. Nickel-plating forms an efficient protective covering to many articles.

(22) Electro-typing is a method of printing. A wax or other mould of the type to be reproduced is faced with graphite on which copper or other metal is deposited electrolytically and then strengthened by a backing of lead or similar metal. On removing the mould, the impression is used for printing copies of the original.

(23) Electrocution is a method of inflicting death penalty adopted in the U. S. A. This form of execution is more nearly instantaneous and less revolting than other methods.

Broadcasting means the transmission of a message—be it musical or spoken—to a great many receivers (or listeners) simultaneously. This is possible because transmission is by wireless waves sent through the ether, and not by sound waves passing through the air. The broadcaster employs ether waves, which do not depend upon the existence of the air to carry them. You shout a hundred yards,—you can broadcast all round the earth. Using an enormous loud-speaker to magnify your voice, you might be able to be heard five miles away. The true invention in broadcasting is the use of these silent penetrating wireless waves and the modulation of their intensity in accordance with any sound. These modulated or varying intensity waves are picked up on a receiver and are made to operate a loudspeaker. Broadcasting stations commonly send out frequencies,

in other words, wave-lengths, which may be anywhere between one million five hundred thousand vibrations a second and one hundred and fifty thousand vibrations a second. Of course, the wireless waves are at their strongest near to the place whence they are sent out and get feebler as the distance from the place of transmission increases.

Wireless Wonders.—(1) A motor boat steered and propelled under the control of wireless, without the presence of a single person on board. (2) A control ship controls a crewless ship by wireless. (3) A seaplane can direct and fire the guns on board a radio-controlled and crewless warship. (4) Pictures can be received in the air. Photographs and writings may be transmitted equally well by wireless as by wire. (5) A pilot can be informed by wireless of the state of the weather on his course, of the position of other planes and of the route he should pursue. (6) A submarine oscillator can detect the presence of submarines. (7) Wireless has been the means of saving many thousands of lives. It is, undoubtedly, one of the most important contributions to the safety of life at sea.

Television.—Of the more recent applications of electricity, many consider television to be the most wonderful. To be able to see a distant event practically at the time of happening, and to recognise the features of an absent friend, however far away, seems an achievement of the impossible; yet this is the everyday practice of the television experimentalist. One can see "Derby" at home on a reflecting mirror. A picture of a section of

the course is being televised to thousands of homes.

Electric Railways and Tramways.—Electric trains are propelled by motors mounted on the driving axles of the locomotives or the passenger coaches. Current is led through the windings of the motor armatures, causing them to revolve or turn the wheels of the train. Either alternating or direct current may be used.

Household works.--Electricity does the works of a vacuum cleaner and door-opener; by means of thermostat it warms the room to required temperature, drives away the moisture of rooms, will light up a room automatically by photo-electric cell when darkness envelops the room, and will heat your stove between midnight and 6 a.m. and cook your food; you can regulate the heat of the stove say 200°F or 400°F by turning a simple "pointer" to the temperature required. Clocks will be electric and accurate, but there will also be an electric alarm clock. If you set a pointer to a figure denoting the number of minutes required for cooking a certain food, when the time comes, the electric clock will break the circuit, and the oven will be turned off. In an automatic bathroom you will find lamps giving artificial sunshine. A thermostat will warm the bathing water to required temperature.

Cinemas and Talkies.—On account of cheap exhibitions of cinema shows, Indian students are not inquisitive to know about the wonderful invention. Millions are everyday deriving pleasure by seeing the fictitious scenes in thousands of shows, in the principal cities of India; but only a few men or students acquire education by this

means. I do not know when Indian schools and colleges will awake from a long sleep of about 20 years and take advantage of cinemas and talkies in spreading useful knowledge amongst students by this simple and vivid method of education. Educational lectures repeatedly delivered by these appliances are needed. Talkie is a more wonderful invention than cinema.

In an automatic house windows and doors may be opened and shut simply by saying a suitable word or by whistling at a certain pitch. When you are away from home, you can ring up on the telephone, and a "robot" nurse will inform you if the baby is crying. If he is, you can set on electrical rocking machine in action. These descriptions are not fanciful. Each one of these devices is in use somewhere. Wires will bring comfort, health and amusement to the home. The greatest benefactor that Industry can have in the near future is more and better distributed electricity.

There are electric automatic restaurants and hotels where bread-slicing machine, fireman, boot-cleaner, ticket printer; and wireless set, gramophone, talkie and cinema projecting apparatus, are all combined. Time-keeper, loaf-counter, change-giver, coal-plant, emptying of coal-wagons, automatic lamp-lighters of streets, turning night into day, 20,000 candle power electric lighthouse; traffic control in crowded streets from the air (the pilot, communicating with the police by means of radio-telephony, can stop traffic at certain points and divert it along the roads as may be necessary), traffic control by a pedestrian in crossing a street,

police signal caution of "stop" or "go", when a section of a road is in repair, automatic traffic signals operated by means of photo-electric cell, etc. are wonders of electricity.

An electric machine can 'read', classify and sort bills, tickets, cards and other records very speedily, placing each in any appropriate one of 100 compartments.

Electric devices have been made by which (1) motor-cars are controlled as if by commands such as" Start", "Reverse" and "Stop"; (2) the blind can read ordinary print; (3) train can be controlled. With electricity, all the lights of a huge city can be turned on by the simple turn of one switch. Again, by connecting up lamps in circuits half the lamps can, if desired, be turned out at midnight. Now-a-days electric street lights turn night into day.

Electric clocks.—A new era of time-keeping by means of electric clocks is dawning, in which exact time will be brought into our homes and offices by a radically different method which requires neither pendulums nor escapements. In England, it gives the correct Greenwich time, because it is a synchronous electric timepiece. There is no use of winding or regulating it. It does not tick.

Glass roofs will admit daylight to a certain extent, but permanent "sunlight" will be ensured by artificial illumination. Ultra-violet ray lamps will give health, and great electric lamps more light, so that we shall be independent of rain, fog, sunshine, or snow.

A giant searchlight is made 14 feet in height

including the trolley over which it is placed, and the projector has a diameter of 7 feet. It will throw a beam of 3,500,000,000 candlepower and can be seen for miles.

Flood-lighting literally means flooding with light. We may call the light of the sun flood-lighting. June sunshine in the south of England is 1000 times stronger than the brightest office, factory or room you have ever seen. Flood-lighting is a nice device by which large buildings, parks, etc., are illumined at night. It is directed on the object to be lit in such a manner that there is no direct light in the line of vision, otherwise the intense power of the concentrated beams of light will cause discomfort to the eyes,—far more than the blinding glare of powerful motor car headlights on a dark country road. A tower is naturally lighted by the sun's rays falling downwards; but the artificial flood-lighting of such a tower is to be carried out by upward rays on four sides. A white stone structure reflects the light properly; a red brick building, or a black tarred barn absorbs it. In some cases so much as 70 percent of the light is wasted. Now flood-lighting is used in railway goods yards, docks, wharves, collieries, playgrounds, etc. Interior of churches, hotels, dance-halls, cinemas, theatres, etc. are flood-lighted.

Illumined fountains are pleasing sights. The lights that illuminate the jets of water are constantly changing colours; by turns they are green, yellow, orange and red; and the tints assumed by the water are very beautiful.

The illuminated motion sign is another phase

of lighting—though not strictly flood-lighting. In some of these signs there are at times as many as 5,000 electric lamps of different colours,—which act as flash lights.

"Doctor Electricity".—Electricity is administered to the body in curing rheumatism, cramp, paralysis, and nervous diseases. Paralytic patients have now been cured by short-wave radiations.

Electro-cardiograph is extremely useful in diagnosing a case of suspected heart disease. It is an extremely delicate apparatus measuring currents, or their results, so minute that they can be conveniently recorded only with the aid of a microscope.

Electricity is used by doctors in many different types of lamps for producing heating rays. The discovery that some of the ultra-violet rays given off by the sun can be produced artificially, was one of the greatest of medical science. Thousands of children born in crowded and sunless cities seemed doomed to contract rickets. Then came the discovery that this disease of childhood was due to a deficiency of certain vitamin, and finally, that this vitamin could be artificially produced by the effect of ultra-violet light. Rickets is rapidly becoming a thing of the past.

Different types of lamps produce different rays, most of which have been used in medicine. Infra-red rays are used in the treatment of certain diseases; and X-rays are absolutely indispensable to the medical profession to locate the position of a needle or bullet, or where fractures of bones have been made.

Electro-magnet withdraws minute fragments of steel, which get in the eyes in factories, without injuring the delicate tissues of the eye.

The surgeon has found that electric knife is more effective for many purposes than the old steel blade. Electric surgery is, of course, bloodless, and particularly suited to the removal of certain growths, such as enlarged tonsils. The heat is produced in the 'knife' electrically;—it does not really cut, but it burns. The great advantage of the electric knife is, perhaps, that there is less risk of infection, the various unwanted bacteria being killed by heat.

Electric vibrator serves the purpose of massage, gives tone to the nervous system, energises the dormant muscles, disperses congested blood and removes some kinds of local pain. Policemen utilize electric vibrators to keep themselves fit and to keep down weight. Electric tooth-brush with its battery in the handle can be carried in a lady's handbag.

Electric water-baths are efficacious in curing several skin diseases and giving tone to the system; and in removing local pains by local application of electrified water.

Cabinet Hot Air Bath can be set up in a bed room. The person should be on a chair. About the chair, upto the neck of the person, a thick covering of canvas should be arranged; so that the head, being projected above the covering, might breathe the ordinary air of the room. The air is heated by one or more electric lamps kept under the chair. After a stay of 10 to 20 minutes, the person steaming with perspiration comes out.

Then he can bathe in a bath-tub full of tepid water, warmed by one or more electric lamps.

Electric Light Cabinet is of the above nature, but the person lies down on a bedding covered over with a semicircular canvased roof about 2 ft. distant from the body, upto the neck, so that the head, projected beyond the covering, might breathe the air of the room. The head should be covered with a wet sheet,—the whole naked body being placed within the cradle. Inside the top of the cradle 8 or 12 electric lamps should be attached so that light and heat from the lamps might fall on the naked body, and heat the air within the covering or cabinet to a certain extent. The person profusely perspires in 5 or 10 minutes. He should then bathe in ordinary tepid water or electrified tepid water. Electric light may be varied by various coloured lamps, or reflectors, or coloured glasses or coloured celluloid sheets to serve the purpose of chromopathic treatment.

Security of Valuables.—Safe Deposit Houses, Banks, Treasuries, etc., can be made safe against thieves and burglars by means of suitable electric appliances. Self-acting loud sounds of bells or whistles or strong flashes of light might warn the patrolling guards or policemen on the entrance of intruders; they might be captured by electric devices; or laid down by electric shocks; or self-acting phones can create alarms in the distant police stations, etc.

Marvels of Telegraphy.—The teleprinter is a combined transmitting and receiving instrument, and is capable of printing the message either on a paper slip or in column form on a sheet of paper.

It is really a telegraph typewriter capable of printing a message simultaneously on both the transmitting and receiving instruments. The maximum signalling speed is fixed at 66 words per minute, say, one word a second. Ocean cable printer signals are sent as by different dots denoting 26 alphabets. For telegraphic communication with ships at sea or over very long distances, radio methods are employed. Recently, systems of facsimile telegraphy, whereby a photograph, drawing or even the manuscript of a letter may be transmitted electrically from one point to another, have been invented and brought into use. This system may also be used for the transmission of weather maps to the captains of airships and to aviators in general.

Telephone Wonders.—Modern telephone exchanges are of the automatic type. Some of the 50 volt batteries for an automatic telephone exchange weigh over 100 tons, and supply enough energy to light nearly 1000 houses. By means of a wonderful telephone, the manager of a large office can speak to the heads of several departments at the same time and receive their replies. There is an apparatus which assures secrecy in telephone conversations. By turning high notes into low notes and *vice versa*, it renders words unintelligible, producing a strange jargon that is translated into intelligible speech at the receiving end.

Household works by electricity.—It does the laundry works, can dry the body after bath in a few seconds, by electric hot-air distributor, dries damp hair by electric bellows, electric razor can

shave quickly and cleanly without soap-water, washing-up machines, clean dishes, etc. The whole motor-car can be painted with sprays or cleaned in a few minutes by motor-pumps.

Electric Railways and Tramways.—About 50 years ago the first electric railway in the world was opened, and today about 10 thousand miles of track are electrified chiefly in the U. S. A., Switzerland, France and Italy. Electric trains can be accelerated two or three times as quickly as steam trains. On pages 153 and 154 of this book, you will find a short description of the underground railways of London.

Electricity on Board Ship.—In a modern liner, lighting, heating and cooking are done electrically; ventilating fans, refrigerators, steering gear and deck and engine room machinery are driven by electric motors, and for driving propellers, the most important duty of all, electricity is being used more and more. In the *Monarch of Bermuda* lighting is provided by some 20,000 lamps, the cabins are heated by 400 electric radiators, and ventilated by 650 electric fans. No less than 410 miles of wire and cable were used.

Gyroscope.—There are but few things that engineering skill has produced for the equipment of ships that can compare to interest and importance with the gyroscope and the application to which it is put. Action of gyroscope should be explained by teachers by a spinning top or a rotating hoop.

The museum should keep a piece of submarine cable and some pictures of processes by which it is laid in the sea.

The "Dynasphere" might be the car of the future. The outer wheel, 10 feet in diameter, revolves and travels forward around the driver, whose seat remains at the bottom, due to gravity. The Dynasphere is driven by electricity, or by a small petrol motor, and is capable of a speed of 30 miles an hour.

Electricity on the Farm.—Out of 418,000 farmers in England about 4,000 take advantage of electricity. In other countries over two million farmers use electricity. There are over 300 different uses on the farm, in the barn and in the homestead. Let me mention some of them:—Lighting the cow byres, driving milking machine, thrashing machine, vacuum carpet-sweepers are used for grooming the horses and cows and also for cleaning down walls of buildings and mammoth incubators; electrically charged screens at the doors and windows electrocute flies and other insects as they attempt to come in (they are harmless to human beings and livestock). By heating the soil with electric tubes embedded in the ground, the farmer gets profit by growing flowers and vegetables out of season. In poultry farms 16,000 to million eggs are hatched by nice arrangement in the electrically heated incubators. Twice a day chicks will have ultra-violet light treatment to make up for any sunless days. In such a poultry farm one boy and one man can look after 3,500 birds from chickendom to two years old.

Electricity in Animals.—A startling example of the natural production of an electric effect in animals is to be found in the electric eel, which

inhabits the rivers of South America. This fish can make contact with an enemy and thereby inflict an electric shock, or rather a series of electric shocks, sufficient to stun its opponent. The nerves and muscles of all animals, man included, generate electric currents as they perform their normal functions. There are two classes of nerves;—sensory nerves, carrying messages, usually resulting in sensations, from the various parts of the body to the brain; and motor nerves, carrying messages or commands from the brain to the muscles, and setting them in motion. The electric effects on them have been faithfully recorded by scientists.

Trams and Trolley Buses.—In them the axles of the driving wheels are mechanically coupled to electric motors supplied with direct current upto 600 volts. The electric equipment includes motors, control gear, current collectors and brakes. Current in most cases is taken from overhead "track conductors". Trolley buses run on the road surface, needing no rails, and take their current from overhead conductors. Unlike tram, trolley buses require two overhead wires, one positive and one negative, and therefore duplicate trolley poles. Trolley buses are particularly useful where the streets are narrow, and they form a comparatively cheap method of extending a tramway system requiring infrequent service.

Electric Welding.—Fractures in steel parts can be perfectly repaired, worn parts can be renewed, and great ships built, in which riveting is entirely replaced by electric welding. A cylin-

drical tank, 3 ft. by 5 ft. in diameter, can be welded in a second.

Refrigerator.—The storage of food in a refrigerated room or a cabinet, retards the growth of bacteria, moulds (fungous growth or discoloration) and other organisms which feed on fresh food and turn it "bad". These organisms grow best in a temperature between 60° and 122°F, but they become dormant at temperatures below 50°F. Freezing will destroy most moulds, but not bacteria.

Cranes and Lifting Magnets.—A floating crane, mounted on a raft, will lift many hundreds of tons. The powerful electric motors are very small in relation to the size of the crane itself. Instead of grappling hook to the end of the crane cable is sometimes fixed a large electro-magnet. Lifting magnets raise pig-iron, ingots, hot ingots, etc. It sometimes breaks up the scrap metal into a convenient size to enable it to be placed in the furnace for melting down. The lifting magnet raises a huge steel ball, or "skull cracker", to a sufficient height above the pit containing the scrap; the electric current is then switched off from the magnet, with the result that the "cracker" crushes down, breaking up the metal.

Bridges, Cable Railways and Ropeways.—Two leaves of a lifting bridge are raised or lowered by electric power. The Transporter bridge consists of two huge towers built on each bank, and joined by girders at such a height above the water as to be clear of the shipping. Along the girders a powerful electric locomotive traverses, and from this the platform or trolley,

on a level with roadway, is suspended by steel cables. Cable Railways and Ropeways for industrial purposes, for handling coal at the pithead, for removing refuse to coal "tip", etc. are invariably operated by electricity. There are remarkable railways for ascending high mountains,—the gradients are often so severe that the car appears to be leaning at a perilous angle.

Noises are Recorded.—Sound-measuring equipment is made in portable form and can be taken outside the laboratory, being employed to measure the noise of tube-trains, motor-cars, and all types of machinery. The records are used by engineers in their attempt to eliminate as much noise as possible.

A Skygrid.—A 3,000,000,000 candle-power searchlight throws a "grid" on the sky by means of which the speed, direction and height of raiding aeroplanes can be quickly calculated. Once caught in the rays, the planes find it almost impossible to escape.

XXIII

SOME OTHER SCIENCES

A. Geography and Physiography

The following articles should be kept in the Museum ;—some good books on geography and atlases, one globe of at least 12 in. dia., one small ball of about 2 in. dia. to represent the moon, and a strong electric or acetylene lamp to

represent the sun. The globe, etc. should be rotated in such a manner by some simple mechanism, that the earth at $22\frac{1}{2}$ deg might be moved in a circle*. By a separate arrangement the movements of the moon round the earth can be shown, and also its different phases.

At the equator the durations of day and night are the same throughout the year, that is, all the days are 12 hours long and all the nights are 12 hours long. At 45 deg. latitude, the sunlight stays $15\frac{1}{2}$ hours, in summer; at $62\frac{1}{2}$ deg. (i.e. arctic circle), 24 hours day; at 70 deg., 65 days; at 80 deg., 134 days ; at 90 deg., 6 months. In winter the nights are as long as the days noted above.

By means of lights and shades solar and lunar eclipses can be explained; similarly revolution and phases of the moon can be shown.

Earth.—Shape, sizes, velocity, weight, gravitation, poles, zones, meridians, latitudes and longitudes, rotation and revolution, crust, trade-winds, monsoons, seasons, equinoxes, and solstices, tides, solar and lunar months and years, variations of time and standard times, rainfall, climate, atmosphere, breezes and strong winds, etc., should be explained with the help of maps and drawings. Planets, comets, and meteors are to be shown by means of pictures. A frag-

* Although the orbit of the earth is slightly elliptical (only 2 per cent.), most of the school atlases have wrongly shown the orbit as 100 per cent. elliptical, that is, the breadth of the ellipse is shown as half the length of the ellipse. The teachers should point out the mistake; and explain that on account of the stronger perpendicular rays of the sun, it is summer, and for the weaker oblique rays, winter occurs. Moreover, summer has longer days, and winter, shorter days.

ment of a meteorite (if available) should be shown to the students.

Natural Phenomena.—All students of physiography should have some knowledge of the phenomena either by visiting them if they can ; or by seeing the exact pictures of the phenomena, taken by camera. Therefore, the Museum should collect their photographs or photo-prints, and paste them in a blank book with short descriptions of them cut out from a dictionary or typed. A short list of such natural phenomena (that is Wonders of Nature) is given below:—

Mountain, Sand-storm, Sunrise, Meadow, Volcano, Crevasse, Midnight, Savanna or Savannah, Prairie, Rapid, Cliff, Pompas, Glacier, Whirlpool, Moor, Swamp, Oasis, Waterfall or Cataract, Morass, Desert, Iceberg, Bore, Moraine, Tableland or Plateau, Geyser, Hailstone, Mist, Sylva, Halo, Cyclone, Sunset, Snow, Grotto, Lagoon, Valley, Snowfall, Reef, Breaker, Ford, Sand-drift, Mirage, Earthquake, Ignis fatuus or Will-o'-the-wisp, Sand-dune, Meteor, Gulf, Inlet, Pool, Isthmus, Lake, Gorge, Delta, Hill, Stormy Sea, Brook, Estuary, Hillock, Calm Sea, Storm, Coral-ísland, Beach, Peninsula, Creek, Dell, Fiord or Ejord, River, Cascade, Basin, Stratum, Tributary, Precipice, Bay, Island, Puna, Strait, Cape, Rainbow, Forest, Woodland, Channel, Aurora Borealis, Glen, Frozen Waterfall, Mount, Avalanche, Submarine Forest, Ocean, Promontory, Kinds of Clouds, Waterspout, Kinds of Lightening-flashes, Dale, Simoon, Cave, Steppe, Whirlwind, Ravine, etc.

The following Comparative Charts should be prepared and pasted on a blank book to be named 'Geographical Charts,'—which should be also printed in new Geography Books for Indian Students.

(1) Ten largest mountains, rivers, seas, lakes, deserts, cataracts, volcanoes, etc., of the world.

(2) Populations of ten biggest countries and largest cities, etc., of the world.

(3) Largest productions of the principal grains, food-stuffs and metals of the world in different countries.

(4) Religions, races and languages of India.

(5) Average temperatures and rainfalls of different Provinces of India.

(6) Extraordinary temperatures and heights of different places of the world.

(7) Railway Routes of India.

(8) Routes of cables, steamers and aeroplanes.

(9) Quantities and values of the principal exports and imports of India in a year.

(10) Table of principal Industries of India.

(11) Table of principal mineral, vegetable and animal products of India.

(12) Table of principal occupations of the Indians.

(13) Charts of important imports of India from Great Britain, U.S.A., Germany, Italy and Japan and of exports of India to these countries.

(14) Selected extracts from the Census Report of India of 1931; and similar other tables.

Remarks on the Study of Geography and Physiography.—It is not necessary for the matric students of India to commit to memory

the products of the three kingdoms and the physical aspects of countries other than India. Higher class students might study bigger books to acquire more knowledge of other principal countries, if necessary. In the second matric class, three months are quite sufficient to learn general geography and three months, to learn regional geography; and students should be taught Indian history in three months and elementary principles of physics with illustrations, in three months. In the matric class, 12 months should be divided thus,—English history, 3 months; physical geography, 3 months; elementary electricity, 3 months; elementary mechanics, 3 months. We should not over-tax the memory of young boys and girls with unnecessary facts of history and geography. To successfully effect this reform, the size of text-books of history and geography should be reduced to one fourth of the present size;—they should contain only most important facts, which cannot be left out.

(2) In geography, names of several natural and artificial products occur. As most of the students have not seen some of those articles, they cannot form correct ideas of them by mere explanations of the teachers or from their descriptions given even in big dictionaries. Therefore, it is of utmost importance to collect them either in schools or colleges and Museums.

(3) In these days of advanced stages of photography and photo-prints, and chromo-lithos, there are a number of nicely illustrated popular books by the perusal of which students can form sufficiently clear ideas of natural phe-

nomena, wonderful works of human art; as well as of ethnological, anthropological and archaeological objects. One in 10,000 students of India can have direct visual knowledge of these things throughout the world. Very interesting and useful books containing descriptions and illustrations of the peoples and lands of the world,—of the dwellers of caves, mountains, forests, deserts, ice-houses, river-boats, thick jungles, houses over shallow water, cavities of ancient trees, etc., and their curious dresses, ornaments, armaments, tattooing ; useful and wonderful animals, fishes, birds, insects, etc., extinct animals and skulls of prehistoric men; animals of the deep sea, etc., are available at modest prices. Such books have more educative value to the majority of students than the few dead animals preserved in Indian Museums or Zoos. Most of the village people and students cannot visit Museums of big cities. These books should be procured for *zilah* schools (at least), colleges, and Museums.

(4) As a large number of students have not seen the principal edible fruits, vegetables, tubers, different rices and wheats, pulses, dried fruits, of India and also those which are imported in India from Java, Afghanistan, England, etc.; and do not know their food-value in health and disease; their models should be kept in the Museum with short descriptions. Books on Ordinary Foods should be published.

(5) For teaching the above subjects, popular lectures by means of magic lanterns or cinemas should be arranged. Film-talkies depicting scenes and sounds of roaring lions and tigers, hissing

serpents and rattling snakes, prairies on fire, land of 10,000 smokes, oases and mirages in deserts, live volcanoes, animals of the zoos of other countries, tobogganing or skating on ice, wonders of the sea, waterfalls, interiors of aeroplanes and steamers, working of their machines, moving of liners on oceans, turbulent seas, aurora borialis, underground railways of London, skyscrapers and busy streets of New York, and a number of natural and social scenes, etc., too numerous to be enumerated here, should occasionally entertain the students and the public.

B. Astronomy

"By examining rocks upon the earth, we are able to guess that men have existed for hundreds of thousands of years, while the earth itself is about 2000 million years old. For millions of years it was merely a fiery mass, like a small sun. The coming of life was followed by more millions of years during which man was evolved from simple forms of life. Even when, hundreds of thousands of years ago, man is something like our own likeness, came into existence; a very long time had to pass before he became intelligent. * * The nearest 'fixed star', which has the unromantic name of Alpha Centauri is about 16 billion miles away. When we begin to explore the universe, distances become so tremendous that we have to abandon ordinary measures, like yards and miles, and speak in terms of 'light-years" that is, the distance light travels in one year,—five and a half billion miles. The light of the sun reaches the earth in 8 minutes. * * The most

remote star seen in the most powerful telescope is 140 million light-years away,—that is to say, the pin prick of light seen in the telescope left the star 140,000,000 years ago—long before man appeared on the earth. * * As the telescope has enlarged our horizon outwards, so the microscope has increased our knowledge of little things. We hear a great deal of talk about atoms, for instance, but how many people realise that there are millions of billions of atoms in an ounce of hydrogen—and our body contains many ounces of hydrogen. You must seem as big to an atom, as the universe seems to you! * * Man has now been living on this little earth probably for two or more hundred thousand years. * * The greatest discoveries of science are that we have all very little knowledge."

No one knows how many stars there are. With our unaided eyes we can never see more than about 2500 on a clear night in England. All the year there are probably not more than 4000 stars which are visible to our naked eyes. But so great is man's ingenuity that he has invented telescopes which can increase this number to more than 1,500,000,000, and beyond these there are millions more out of sight. * * There are green suns and red suns, purple suns and blue suns, orange suns and suns shining with dazzling whiteness. * * There are families of suns, where two, three or more stars revolve round each other in space. * * One fine triple star is composed of three suns, the first of which is orange, the second green, and the third blue."

The Constellations.—"Thousands of years ago

the ancient astronomers saw that the chief stars were clustered together in groups. These groups we call the constellations. The stars are not related to each other, they are countless miles apart, but in the figures they form, the ancients saw the heavenly embodiment of their gods and heroes, and the names they gave to these constellations have come down to this day."

Polar Star (in India called *Dhruva Tárá*),—— for ever it hangs immovable over the earth's northern pole, and round it all the stars of the northern hemisphere appear to circle once in every 24 hours.

The word Zodiac means "little animals". In the sky there are no such 12 figures of the zodiac (12 *Rásis*). By drawing imaginary lines about the constellations the figures were formed. The following are their names in Greek, English and Sanskrit:—

Taurus The Bull वृष *Brisha*	Virgo The Virgin कन्या *Kanyá*	Gemini The Twins मिथुन *Mithun*
Aries The Ram मेष *Mesha*	Cancer The Crab कर्कट *Karkat*	Leo The Lion सिंह *Singha*
Sagittarius The Archer धनुष *Dhanu*	Scorpio The Scorpion वृश्चिक *Brischika*	Aquarius The Water Carrier कुम्भ *Kumbha*
Capricornus *The Shark* मकर *Makar*	Libra The Scales तुलादण्ड *Tuládanda*	Pisces The Fish मीन *Min*

The astrologers of India and other countries calculate the events, circumstances and character of men on the position of the sun in the 12 signs of the zodiac during birth-time and other periods of life.

"Our earth seems a big place, but it is tiny compared with the sun, which is 1,280,000 times vaster in volume, and 324,000 times heavier than our world. The sun has no solid outer shell like the earth, and though to our naked eyes it appears so peaceful, seen through a telescope it becomes a seething mass of fire and swirling gases, a place of frightful storms and appalling volcanic eruptions far worse than any experienced on earth. * * This outermost region is called the *corona* or crown, and stretches out from the sun for millions of miles into space. * * The corona is a vast, raging sea of crimson fire out of which tongues of flame are shooting up into space with frightful velocity for thousands upon thousands of miles. It becomes visible, however, through a telescope during a total eclipse of the sun. * * The sun revolves on its axis in the same way as the earth does, but it does not all revolve at the same speed".

Eight Planets of the Sun.—The earth is not the only child of the sun. There are 7 other planets. (1) *Mercury* is the planet nearest to the sun, and it is also the baby of the sun's family of worlds. It revolves round the sun in 88 of our earthly days. Its path is elliptical.

(2) *Venus.*—Travelling onward from the sun, we next come to Venus, the planet where the conditions are probably most similar to the earth.

(3) Next to Venus comes our own planet *Earth*. Some particulars are given in physiography. Owing to the earth's attraction, the revolution of the moon upon its axis has so slowed down that now it takes the same time to turn round once as it does to revolve once round the earth. The result of this slowing down is that the moon always turns the same face to the earth.

(4) Next we come to Mars, the red planet, 140,000,000 miles from the sun. Mars is about half the size of the earth, and consequently its force of attraction is much less.

(5) Next in space we come to *Jupiter*, a giant in our family of worlds, 88,000 miles in diameter, eleven times larger than the earth, requires nearly 12 earth-years to make one revolution round the sun.

(6) *Saturn* is 886,000,000 miles from the sun. It makes one revolution in 29 earth-years. It is a huge mass of seething gases and metallic vapours, 719 times larger than the earth.

(7) *Uranus* is 895,000,000 miles from the sun. It is invisible, except through a telescope. It is a gloomy planet, and takes 84 earth-years to make one revolution round the sun.

(8) *Neptune*, 2,791,000,000 miles from the sun, travels its dark and lonely road. Neptune takes 164 earth-years to make one revolution round the orb of the day.

The Museum should collect the following things:—a telescope, pictorial books on astronomy, pictures of the zodiac, good photographs of the sun and the moon during eclipses; and at other times, other planets of the solar system,

map of the solar system, maps of the firmament, magnified photographs of the Mars, Venus, Sun, Moon; position of the Polar Star, the Great Bear, Corona and Chromosphere of the sun during its total eclipse. These photographs can be had from some observatories of England or U.S.A. An Astronomy Primer should be published with illustrations in English and vernaculars.

C. Physiology and Pathology

Coloured Charts of the principal organs of the human body should be procured from the Red Cross Society or other publishers. Books known as "*Manikins*" with explanations will greatly help the teachers in teaching the subject. Pictures or models of man's skeleton, brain, eyes, ears, nose, mouth, tongue, dental system, skin; digestive, circulatory and respiratory systems; intestinal, spinal and nervous systems, etc. will be helpful in popular explanations. Students should know the nature of ordinary diseases, their outward manifestations, and their common preventive measures; such as, malaria, smallpox, beriberi, measles, anaemia, etc.; fractures and dislocations of bones and foreign articles, malformations of bones, by X-ray photographs; twins in the womb, living joined-twins, deformities, abnormal growths of some organs, dropsy, rickets, tumour, elephantiasis, intestinal worms, etc. Nicely illustrated picture cards of diseases can be had from some medical companies, such as, Deschiens, (Indian agents, Dastoor, 28, Grant Street, Calcutta and Nusserwanjee and Co., 35, Hummom Street, Fort, Bombay). A big illustrated

Chart 41 in. × 31 in. of Intra-uterine Life (showing gradual development of foetus in the womb) can be had from Dr. G. H. Michel and Co., 3808, Prospect Ave., Cleveland, Ohio, U. S. A.

D. Domestic Engineering

Pictures of the parts of ordinary buildings should be collected and their names to be noted. Samples of building materials of the old and modern times should be exhibited. Originals or pictures of re-inforced concrete should be collected. Although Engineering Colleges teach the subject;—domestic people should acquire some general knowledge for building cheap, strong, sanitary houses.

E. Sanitation and Public Health

These are important sciences for the prevention of plague, infant mortality, epidemics, consumption, gonorrhoea and syphilis, typhoid, cholera, small-pox, etc. In large cities, plumbering appliances for water-fittings, light-fittings, drainage and latrine connections in all houses are necessary. They should be shown in the Museum. School and college students of big cities should possess some knowledge of these things. Books and pictures on the subject of intemperance, intoxication, smoking, evil secret vices, come under the headings of health and sanitation;—social evils are greatly eating into the vitals of inhabitants of big cities. Literature on these subjects should be published in vernaculars. Occasional public lectures should be delivered. If we have a mind to improve our future generation, we should study

the laws of *Eugenics* (the science of improving human offspring) and act according to those laws.

F. Social Science.—Without following its rules no society can prosper. I have dwelt with the subject in pages 184 to 202 of "Educational Reformation in India". In this book I do not find space to deal with it more elaborately.

G. Economics.—I have devoted pages 230 to 250 of "*Educational Reformation in India*" on the subject. Some elementary books should be compiled and taught in schools. Man is a social creature; —material progress of society depends on cooperative system,—which is one of the basic principles of economics.

H. and I. Ethnology and Anthropology

Ethnology is the science which treats of races and peoples, their origin, distribution, relations, and peculiarities. It is an interesting subject for the study of those who have leisure to do so. *Anthropology* is literally the science of man, secondarily the science of the human physiology; in a wider sense, it is the science of man in relation to physical character, distribution, origin and classification of races, environmental and social relations and culture.

Both are nice subjects. It is our duty, first to study physiology, then the rules of health and hygiene, and at last we should study the physical and social defects of ourselves, our family members, inhabitants of neighbouring localities, districts and provinces. Gradually, we can go to the habitations of aboriginal tribes of India for

study or read the present descriptions of their manners and customs in books, and keep their dresses, ornaments, utensils, instruments, etc., in Educational Museums. If the educated people can reform the manners and customs of our homes and districts in their life-time, hundreds of districts will be reformed thereby in course of time. This is the sure practical method of reforming India in this respect. There is no need of spending money to impart theoretical or practical knowledge on the subject in colleges or universities. Educated persons who take interest in the matter can study the books at home, and pass university examinations and get degrees. Rich universities of foreign countries, such as, London, Oxford and Cambridge, can afford to maintain chairs for this subject. Occasional lectures in Educational Museums with the help of the necessary exhibits are sufficient. In the Museums we should keep some heavy, uncomfortable, and insanitary ornaments and dresses of the aboriginal tribes, as well as those of the foolish or ignorant village women of India, or other countries, in order to generate in the mind of the rising generation a great dislike for them and a desire for teaching the women to leave them off. Gradually we can approach the aboriginal tribes and reform them. Two big blank books should be provided for pasting illustrations on Ethnology and Anthropology.

J. and K. Antiquity and Archaeology

Antiquities are the relics, monuments, inscriptions, etc., of ancient times. *Archaeology* is the

study of antiquities; it is also the study of the art, customs, etc., of ancient peoples as shown in their monuments, relics, etc. *Numismatics* (science of coins and medals), *Epigraphy* (science of inscriptions), and *Paleography*(study of art of deciphering ancient inscriptions or writings) are principal branches of archaeology. Some educated persons have a fancy for the science. They have made investigations and written books on them. They have time and taste for these things. I think that only 1 p. c. of the 1 p. c. educated persons of India (that is 1 in 10,000 persons) are inclined towards it. The rich English or American universities have created chairs for these subjects. The Oxford University has chairs for Assyriology (history of the ancient Assyrian or, widely, the Babylonian nation), Byzantine Language (language of Constantinople), Egyptology (the science and study of Egyptian antiquities), Exegesis (critical explanation of Scriptures), Papyrology (science of the writing on papyrus, the pith of this plant, sliced and pressed into a writing material by the ancient Egyptians, Greeks and Romans). It is a happy sign that very few Indians take active interest in these subjects. I admit that these subjects have their utility in historical researches. But I think that even the archaeologists would not assign more than $\frac{1}{4}$ p. c. value to their favourite science in comparison to values of all the departments of knowledge,—fixing the total value as 100. But our Government is spending away thousands of rupees every year in maintaining a Department and making collections of old statues, relics, inscriptions, coins,

etc. If this money is utilized in imparting more *useful* knowledge to the poor students and inhabitants of India, ten-fold benefit can be secured. Goodbye to old statues and buildings; *mandirs* and *masjids*, earthen, stony or metallic utensils of old; uncouth ornaments and dresses; etc. Such antiquated things are of very little use in our present daily life. Pictures and descriptions of some of them are sufficient to get an idea of them. Hungry Indians want bread to eat, and not old stony or metallic articles to look at. Poor Indians want current coins, and not ancient coins. In their stead, we should collect more pictures, models or originals; and the photographs, descriptions and particulars of modern improved, well-lighted, well-ventilated, beautiful buildings; nice sculptures, fancy ornaments, nice dresses, more useful tools, instruments, utensils, furniture, carriages, medical appliances, etc., etc., which supply the daily necessities of life and add to our comforts. They will expand our knowledge, broaden our outlook and direct our inclination in the right groove. But the people need not take the trouble of exercising their brains to gain knowledge of the things of antiquity. We should not think of imitating the university education of foreign countries with our scanty means, but we should try to imitate improved elementary education systems of the great nations of the world,—England, United States of America, Italy, Japan and Germany. I think that with necessary changes they can be introduced in India.

The books published on Archaeology and Antiquity are geneally unintelligible. Therefore, three or four collection books for pasting pictures

on these subjects should be exhibited. Archaeological pictures of other countries should also be pasted. Some interesting coins and medals, or their facsimiles or photographs should be exhibited. In the Museum Library picture-books on the subject should be collected. I think, 1 in 1000 or 1 in 10,000 visitors can gain any useful knowledge by seeing actual curious collections of antiquity.

XXIV

SOME MYSTERIOUS SCIENCES

Throughout my long life I have invariably observed that majority of persons, old or young, illiterate or educated, take great interest in some of the mysterious sciences, specially astrology, palmistry, mesmerism, physiognomy, spiritualism, phrenology, etc. Museum should collect popular books, charts, pictures, etc. on these subjects.

(a) *Physiognomy* is an art of discovering mental characteristics from the outward appearance, especially from the face, configuration, cast or expression of the face, as denoting character,—eyes and nose also indicate a good deal of man's intelligence and inclinations. It is as old as Greece. Pictorial popular books should be collected.—"Face as Indicative of Character", 2 s., L. N. Fowler & Co., 7, Imperial Arcade, Ludgate Circus, London, E. C. 4.

(b) *Astrology* is the science which treats of the influence of the 12 constellations of the stars (द्वादश राशि dwádash ráshi), and the sun, moon, and planets of the solar system, on human affairs. By

the study of "natural astrology", great natural changes in the course of a year are foretold; and great political events and changes are forecast year after year by Indian and foreign astrologers. Indian astrologers made a great advance in this science centuries ago. The names of the 12 constellations and the planets of the sun are given in the chapter on "Astronomy". A pamphlet containing Nativities (*Janmalagnas*) of 1001 persons, "*1001 Notable Nativities*" can be had from L. N. Fowler & Co., London. Horoscopes (*kúndalis* or *koshthis*) are prepared from the *Janmalagnas*. Ordinary horoscopes contain yearly readings, and elaborate horoscopes contain monthly readings. Nativities and Horoscopes of renowned men will be interesting exhibits in Museums. Several *Janmalagnas* have been published in Bengali, for example, those of Srikrishna, Ramchandra, Chaitanya, Napoleon, Queen Victoria, Radhasoámi, Ramkrishna, Keshab Sen, Annie Besant, etc. Popular books on Astrology in English and vernaculars should be published. —"Astrology" by Sepharíal, 2 s. 6 d., William Rider & Co., 8, Paternoster Row, London, E. C.

(c) *Palmistry* is an art or practice of reading chirognomy (character-reading) and chiromancy (foretelling the future), and operates by inspection of lines and markings on the human palm. This form of divination is of great antiquity. Its Sanskrit name is *karakosthi*,—there are Sanskrit books on the subject. Popular books in English and Bengali are available,—which contain explanations of the lines and contain photographs of the palms of great men of hundred years.—

"Practical Palmistry", 1s., published by Ward, Lock & Co., Salisbury, London, E. C.

(d) *Phrenology* is the science by which mental faculties and traits of character can be disclosed by examining the protuberances, each of which indicates different faculty or inclination. In phrenological charts or busts of plaster-of-paris, you will find 42 protuberances on the skull delineating 42 kinds of faculties in *three* groups, domestic, emotional and intellectual.—Phrenological Poster (30″×20″) containing Symbolical Head, Names and Definitions, and Phrenological Model Head (22″×19″) can be had from L. N. Fowler & Co., 7, Imperial Arcade, Ludgate Circus, London, E. C. 4, at 4 s. and 1 s. respectively. "Self-Instructor in Phrenology" by L. N. Fowler, 2 s., can be had from them.

(e) *Mesmerism* is a method of sending a person into a trance or sleep by the use of suggestion and movements of the hands. It was called after F. Mesmer, who used these methods and other aids. Since then great improvement has been made in this art. Popular books are available. "Popular Mesmerism," No. 8, 2½ d., Fex Mc Glennon, 9, City Garden Row, City Road, London.

(f) *Hypnotism*.—Method of inducing a trance-like sleep. Usually the subject is asked to look fixedly at a bright object placed at a short distance above the level of the eyes, causing a fatigue of the nerves. While in the hypnotic state, he responds to the suggestions made by the operator, the effects of these suggestions usually remaining after a return to the normal state. The power of suggestion has been utilised successfully in the

treatment of nervous disorders; especially insomnia, defects of speech, drug-habits and alcoholism. Hypnotiser should be endowed with a strong will and concentration of mind. He can influence weak-minded men to do good or bad acts. The hypnotic subject is sent into trance condition by means other than that of the magnetic flow. There are various processes to induce hypnotism. Wonderful cures by hypnotism are recorded. Hypnotised patients have undergone painless serious surgical operations without anaesthetics. By hypnotism a sleepy person can be translated into a stage higher than sleep. A hypnotiser can hypnotise a patient from a distance by calling up a perfect vision of the person. For the cure of sickness and pain, and for the cure of any immoral tendencies the little one may have, *Suggestion* is unrivalled. *Self-hypnotism* (or Auto-suggestion) can be brought to a pitch of perfection.—"A Manual of Hypnotism", 2 s. 6 d., William Rider & Co., 8, Paternoster Row, London, E. C.—Practical Hypnotism, 1s., L. N. Fowler & Co., London.

(g) *Readings from Handwritings.*—It is an art by studying which an expert can describe the general character and preponderate tendencies of the writers by observing different styles of the handwritings. In illustrated books on the subject, photo-prints of the hand-writings are printed and below them readings by the expert are published. A man can learn the art by closely observing with scrutiny variations of styles of writing.

(h) *Spiritualism.*—It is an art by means of which intercommunication between the living and dead can be established. The intercourse

is usually carried out with the help of mediums, who submit to the direction of spirits having astral body. Some sittings for communication with disembodied spirits are technically called 'seances'. For more than 80 years 'seances' were held in the presence of great scientific investigators under the auspices of the 'Society for Psychic Research of England', who noted down and published remarkable phenomena regarding ghosts, and their dealings and habitations. There is a vast literature on the subject. Photographs of ghosts are printed and their utterings recorded.—"Photographing the Invisible" (88 plates of photographs of Ghosts) by James Coates, 10 s. 6 d. and "Psychic Phenomena" by James Coates, 2 s., L. N. Fowler & Co.—"Evidences of Spiritualism" by J. A. Hill, 1 s., T. C. & E. C. Jack, 67 Long Acre, London, W. C.

(i) *Occultism*—is belief in hidden or mysterious powers and the possibility of subjecting them to human control. There are several kinds of occultism; such as, trance, clairvoyance, clairaudience, somnambulism, theosophy, etc.

(j) *Yoga.*—Thousands of years ago the religious people of India practised *yoga* for the purification of their body and mind. Some of them wrote a number of books on the subject,—some of which have been published. Patanjali wrote his celebrated *yoga* philosophy which deals with *rája-yoga*. Tantric literature generally deals with *hatha-yoga* and describes the 7 nervous centres along the spinal chord. How to get mastery over the *kundalini sakti* (serpent power), how to have ecstatic joys at the spirit-centres and how to have visions

of spiritual lights and to hear spiritual sounds, are very fascinating study. Only the most fortunate people, who are devoted to the Feet of the Supreme Father, can walk on the secret path and reach the goal of human life.—"The Secret Path" (A Technique of Spiritual Living) by Paul Brunton, Rider & Co., 34, Paternoster Row, London, E. C.4.

XXV

SOME MODERN METHODS OF EDUCATION

1st.—*Kindergarten.*—It is a new system of teaching children of primary schools by means of play. The civilized countries have approved and followed this method. It is too costly for the village schools of India to fully imitate the foreign countries in the selection of materials and tools. But by a little judicious selection it would be an easy affair to teach on these lines. On pages 171 and 172 of "Educational Reformation in India" some cheap devices are suggested.—Illustrated books on the kindergarten teachings suitable for India should be published in English and vernaculars. Sample objects and exhibits and productions of little boys should be exhibited in the "Children's Section of Museums".

2nd.—*Ambulance Work* and *First Aid.*—These two measures are very useful in sudden illness and accidents.—Some appliances on these methods should be collected. Books and charts should be exhibited. You will find a short description of First Aid on pages 173, 174 and 175 of "Educational Reformation".

3rd.—*Scouting.*—In course of last 25 or 30 years the scout movement has spread over all civilized countries. You will find some accounts of this method of education on pages 175 to 184 of "*Educational Reformation*".—Some books, pictures, badges, appliances on the subject should be collected.

4th.—*Social Service.*—"Its aims are the development and perfection of the institutions of man's associated life, and the construction of a social order which shall be free from disease, poverty, crime and misery." It has several aspects, which are briefly dwelt with in pages 185 to 202 of "Educational Reformation". Social Museum should be a branch of the Educational Museum. It should contain maps, charts, placards, models, pictures, photographs, magic lantern with a number of lantern slides, etc. made with the object of showing (a) present bad conditions of men, their habitations and their villages; and (b) future improved conditions. As schools and colleges of India are not educating the students in the working of social service, museum authorities can undertake this useful work of education.

5th.—*Puzzles,* etc.—For the education and entertainment of students Museum should collect some puzzles and curiosities, in arithmetic, optical illusions, language, pictures, sciences, cartoons, caricatures, punch, decorations, articles for magical performances, etc.

XXVI

SCHOOL EXHIBITS

School Exhibits are the productions of school and college boys and girls, Indian or foreign, on the following subjects. They should be of the best kind as far as available. They will generate the spirit of emulation in the young people.

(a) Handwriting. (b) Drawing.
(c) Painting. (d) Designs.
(e) Works of Art. (f) Nature Study.

If very good hand-writings, drawings or works of art, etc. by experts, who do not belong to any school, can be procured, they should be exhibited. This will give impetus for improvement not only to the young men, but to the visitors also.

XXVII

Guide Books and Maps

(a) Postal and Telegraph Guides.

(b) Indian Railway, Inland Steamer and Aeroplane Routes, and their Time and Fare Tables.

(c) Guide Books to the principal cities of India, and famous cities of the world, such as, London, Rome, Paris, Berlin, Edinburgh, New York, Washington, Chicago, California, Colombo, Rangoon, Tokio; Cairo, etc.; and of principal countries, such as, India, Ceylon, Burma, Japan, Australia, England, France, Italy, U. S. A., Germany, Russia, Egypt, Turkey, Persia, etc.; situations of hill-stations and sanitary springs of India.

(d) Steamer Routes and Guide Books published by Thos. Cook & Sons, American Express, P. & O. Steamer Co., etc.

XXVIII

Reports, Curricula and Rules

Reports, Curricula and Rules of some famous Indian and Foreign Schools, Colleges, Universities, Museums, Exhibitions, Reports of Education published by Government, Educational Societies*; etc., should be collected.

*Names of some Societies:—

1. Museums Association, through its Empire Secretary, Chaucer House, London, W.C. 1.
2. National Institute for the Blind, 224, Portland St., London.
3. Royal Philatelic Society, 41, Devonshire Place, London.
4. Cremation Society of England, 23, Nottingham Place, London, W. 1.
5. Vegetarian Society, 39, Wilmslow Road, Manchester, England.
6. Simplified Spelling Society, c/o The Cafe, Station Road, Wallsend-on-Tyne, London.
7. British Esparanto Association, 142, High Holborn, London.
8. Eugenics Society, 20, Grosvenor Gardens, London, S.W. 1.
9. Royal Microscopical Society, B.M.A. House, Tavistock Sq., London, W.C. 1.
10. Royal Photographic Society, 35, Russel Sq., London.
11. National Anti-Vaccination Society, 25, Denison House, 296, Vauxhall Bridge Road, London, S.W.1.
12. London County Council, The County Hall, Westminster Bridge, London, S.E. 1.
13. Dr. Barnardo's Homes, 233, Barnardo House, Stepney Cause Way, London, E. 1.
14. Society for Psychic Research, 31, Tavistock Square, London.
15. There are 50 Temperance Societies in London alone; one of them is Anglo-Indian Temperance Association, 3, Home Park Road, Wimbledon, London, S.W.
16. Royal Astronomical Society, Burlington House, London.

XXIX

Directories, Dictionaries, etc.

(a) Directories:—Thacker's Indian Directory; Indian Year Book (published by 'Times of India' Office, Bombay); Books containing Lists and Addresses of Indian Manufactures and Industries.

(b) Illustrated Catalogues of important things:—such as, machines and tools relating to workshop, agriculture, gardening, dairy, spinning, weaving, railway carriages, motor cars, steam engines, etc.; appliances of physical and chemical laboratories; electric fittings and machines, etc.;—several lists have already been enumerated under different chapters of this book.

(c) Dictionaries, Small Cyclopedias and Books of Reference.

XXX

Pictures, etc. of Famous Persons

Pictures, handwritings and signatures of famous persons, with very brief sketches of their lives (as far as possible). British Museum of London sells some facsimile copies of the writings of Shakespeare, Milton; Nelson, and other great men.

XXXI

Commercial Forms and Deeds

(a) Printed forms of Post and Telegraph Offices, Banks, Insurance Companies, Commercial Firms, Railways, etc.

(b) Principal Deeds and Documents in English and local Vernacular in original or copies.

(c) Original principal *Khátá*-books in Vernacular.

XXXII

Useful and Interesting Information & Statistics

Statistics of India and other countries (closely connected with India) for making comparisons,—with regard to mortality, education, climate, imports and exports, principal products and manufactures of India. Selected important extracts from Census Report of India and other useful Tables of educative value.

XXXIII

Museum Library

It should contain such books, charts, maps, etc. as are necessary for imparting education through museum exhibits. It should contain:—

(1) "Museums of India" by S. F. Markham and H. Hargreaves (can be had of Taraporewallah & Sons, Bombay). This book contains all the necessary particulars of 105 Museums of India.

(2) Lists of Technical Schools and Colleges in India.

(3) Whittacker's Almanac.

(4) Pear's Encyclopedia.

(5) Watt's "Commercial Products of India".

(6) Reports of Exports and Imports of India.

(7) Meteorological Report of India (for one year).

(8) Illustrated Unabridged Webster's Dictionary.

(9) Sanskrit, Hindi and local vernacular Dictionaries.

(10) Brief Guide to the National Museums and Galleries of London, 6 d., H.M. Stationery Office, Adastral House, Kingsway, London.

(11) Londoner's Education, 1 s., University of London Press, 17, Warwick Square, London, E.C.4.

(12) The World's Wonders, Rs. 10, can be had of Standard Literature Co., Old Court House Street, Calcutta.

(13) Pictorial Education, a monthly journal, Rs. 12 per year, Evans Bros, Montague House, Russell Square, London, W.C. 1.

(14) National Geographic Magazine, yearly $ 3·50, National Geographic Society, Hubbard Memorial Hall, Washington, D.C., U.S.A.

(15) World of Animal Life, 224 illustrations, 6 s., Blackie & Son, 50 Old Bailey, London, E.C. 4.

(16) Animals of All Countries in 50 parts, about 50 s., Hutchison & Co., Paternoster Row, London, E.C. 4.

(17) Audubon Bird Cards, 50 coloured cards, $ 1, National Association of Audubon Societies, 1974 Broad Way, New York City, U.S.A.

(18) Wonder Books of:—

(a) Do You Know? (b) Tell Me Why? (c) Machinery, (d) Electricity, (e) Science, (f) Inventions, (g) Animals, (h) Railways, (i) Ships, (j) Aircraft, (k) Wonders, (l) Nature, (m) Engineering Wonders, Rs. 3-6 per copy, published by Ward, Lock and Co., London,—can be had from Indian School Supply Co., Dhurumtolla P.O., Calcutta.

(19) Reports and Catalogues of one dozen

principal Museums in India, England and U.S.A. should be collected. Descriptions of 14 National Museums and Galleries of London are given at pages 38 to 44 of this book.

Note.—I have given some hints for the collection of some books only. But the Curator will procure such books, reports, etc., according to requirements and circumstances.

XXXIV

CHILDREN'S MUSEUMS

"The natural means of study in youth is play."
—*Playway in Education*.

The first Children's Museum was started in 1899 at Brooklyn, a part of New York City, U.S.A. Now more than 40 cities of U.S.A. have such museums. The first Museum is annually visited by half-a-million children.

This book will be incomplete if a few lines are not added at the end, advocating the importance of Children's Museums, in the different localities of big cities, and the village schools.

I entertain a lingering hope that at least one dozen active men, who are actuated by a strong desire to educate little children by suitable means, will come forward and start Children's Museums, as soon as possible with a few rupees. Retired school-masters or young under-graduates or intelligent active men can work for such an object with a small remuneration. I request the readers

of this book to study 10 pages of Chapter III (Education by Museum) of "*Educational Reformation in India*". The contents of a Children's Museum should be such as are suitable for children of India. I have a very limited space to insert a list of the articles to be collected, yet I mention some of them to give a faint idea.

1 Toys made by folding and pasting papers.

2. *Cauris* (conches), big seeds, or abacus for counting numbers; alphabet-cards and number-cards.

3. Earthen fruits and vegetables. Leaves of common trees. Edible grains.

4. Puzzles, card-houses, sun-dried or burnt bricks (say $3'' \times 2'' \times 1''$) of different shapes for building rooms, pillars, arches, etc. with sticky earth and lime for white-washing them.

5. Wooden or metallic toys, dressed dolls, rubber dolls, moving motor cars, railways, steamers, aeroplanes, etc.; scientific toys.

6. Playthings, such as, marbles, tops, balls, skipping ropes, kaleidoscope, stereoscope, etc.

7. Pictures of insects, snakes, birds, fishes, quadrupeds.

8. Pictures of volcanoes, mountains, seas, lakes, etc. and amazing artificial objects, as, bridges, skyscrapers, light-houses, etc.

9. Musical instruments which can be played by children.

10. Paper masks, fancy dresses, gramophones.

They should be taught drilling, marching, dancing and singing in groups; how to dress properly; how to clean the different parts of their body, etc.

Picture books, models and small curiosities of educative value should be shown and explained to the children. Suitable books in vernacular should be published.

XXXV

SUGGESTIONS FOR REFORMATION

The object of all public museums should be dissemination of knowledge. No museum in India was, however, started with this sole motive. Even after their existence for many years, they have sadly failed to fulfil this object. The Empire Secretary of the Museums Association and a former Director General of Archaeological Survey of India, after examining 105 museums of India in 1936, have published a very useful book entitled the "Museums of India", in which detailed workings of these museums have been described. The public were in the dark as regards the existence of so many museums in India, their location, descriptions and other particulars. The learned authors, therefore, deserve heartfelt thanks of all the well-wishers of museums. In that book they have stated that, "In not a single Indian museum, so far as we are aware, is there that intimate link between schools and museums which is such a feature of the museum service of the U.S.A. and several European countries. Museums in India have in the main adopted a purely passive attitude to education." (page 74). Although these gentlemen are in favour of education, they

have not formulated a definite detailed plan for the purpose. The Bengalis call a museum *jádú-ghar* (magic house) and the people of U.P. and the Punjab call it *ajáyab ghar* (house of curiosities). Indians have a notion that a museum is nothing but a collection of curiosities. Even in 1849 such a learned body as the Asiatic Society of Bengal branded the museum collections as "curiosities" (page 75). It is, in my humble opinion, high time to rectify this initial blunder.

2. Let me now note down some interesting facts cited in the book. According to the census of 1931, India's population was 353,000,000, about $\frac{1}{5}$th of the whole world. While Europe has over 5,000 museums, India has only 105. The annual expenditure on them is about Rs. 700,000. Out of these 105 museums, 37 are directly administered and financed by the Government of India or Provincial Governments. There are 27 colleges and universities, which have their own science museums. 27 museums are administered and maintained by Indian States.** "In India as a whole there are 19 museums devoted entirely to archaeology and 16 devoted to what might be termed historical material in the widest possible sense, while no less than 35 other museums have archaeological or historical collections.** Broadly speaking, therefore, it may be said that more than half of the museum collections in India consist of archaeological or historical material (page 43). Out of 35 museums of antiquity, the Archaeological Survey has developed a dozen local museums," such as, Harappa, Mohenjodaro, Sarnath, Nalanda, Taxila, Sanchi.

3. There might arise several questions regarding the education of the visitors of museums. Take the case of Bengal, the population of which is 50,114,000;--out of which I think 90 per cent never go out of their villages, and consequently could not visit any museum at all. Moreover, 95 per cent of people are illiterate. Most of the young students of Bengal, living at a distance from Calcutta, never visited the *Indian Museum* of Calcutta. The annual number of visitors to it is said to be about 15 lacs. Out of those 15 lacs of visitors only one per cent, that is, 15,000 might be educated. By examining them you will find that only 10 per cent out of the 15,000 possess a desire to learn and have 'eyes' to see. These 1,500 persons shall have to go away disappointed, unless proper guides explain the particulars of some objects to them. When such is the state of actual facts, if the Indian Museum boast of 15 lacs of visitors, who gain some knowledge by their visit, that would be nothing but vain boasting. Again, out of these 15 lacs, hardly 5 lacs are the inhabitants of Calcutta and the rest are outsiders, who visit the cosmopolitan city for private affairs and go away after sight-seeing. They are mere curiosity-mongers, and are satisfied by having a cursory look at the exhibits. I have singled out Bengal to exemplify my point. Such is, however, the case with almost all the other Provinces also. To make a careful study of the various articles of a museum, one requires to pay several visits, each extending over several hours.

4. Another question that might arise is, how many visits of how much duration are necessary

to gather museum knowledge ? My reply would be that the number of visits and their time-limit will considerably vary according to the nature of the exhibits and the mental capacity of the visitors to gather knowledge. An intelligent visitor can find out distinctions between different Indian pulses as regards their shapes, colours and properties in one or two hours. But it would take 5 or 6 hours for him to understand the workings of a steam engine by observing the movements of its different parts in a working model, if the parts are opened and explained by a teacher. In like manner many hours might be required for gathering a general knowledge about a clock, or a motor car, or an aeroplane, etc. But those visitors can understand better who have previously studied elementary principles of physics and mechanics.

5. There are only two methods by which museums can discharge their duty to educate,—either by collecting articles to be explained in the museum and appointing teachers for explaining them; or by lending them to such schools as already have competent teachers on their staff. If the museums fail to discharge this duty, there is no use in maintaining them. The existing museums are not better than *jádú-ghar* or *ajáyab ghar*. If they must fulfil their educative purpose, they should be transformed into 'store house of knowledge' (*jnán bhándár*). All those, whether curators or others, who believe that by simply paying random visits to museums, like *melás* or *mandirs*, once, twice or thrice, one can gain knowledge of exhibits; are labouring under a great delusion.

Education through museum is neither child's play nor magical performance.

6. I will now submit a few practical suggestions for reorganising the museums to make them capable of imparting useful general knowledge.

A. An All-India Museum Committee should be formed, composed of elected curators, principals of colleges, and independent competent educationists nominated by the universities, for the supervision and reformation of the museum affairs.

B. India Government, Provincial Governments, Indian States, District Boards, Municipalities should provide more liberal funds for the maintenance of museums. Universities, colleges and schools should also make contributions. Also a central fund for museum education should be created.

C. Elementary books and illustrated charts on useful subjects should be compiled by experts and published. In this book, I have suggested suitable subjects on which illustrated books should be published.

D. The various museums should co-operate amongst themselves, as well as, with the Provincial Education Departments, universities, colleges and schools.

E. The experienced authors of the book "The Museums of India" have given certain valuable pieces of advice, which should be followed as far as practicable. The articles should be kept clean, well-arranged, distinctly and intelligently labelled; put in different rooms (or show cases); free from dust, insects, sunshine, summer-heat and dampness. Valuable perishable textiles and rare writings should be kept in airtight cases. Valuable

coins and jewels are to be kept under lock and key.

F. All museums should print Guide Books and, if possible, Catalogues. Photographs of exhibits having special educative value, should be printed and sold, and sent to other museums for public display. Catalogues should contain lists of numbered articles of different departments, with explanatory notes, which will answer the purpose of verbal explanation by guides, whom few museums can afford to employ.

G. They should collect select photographs and charts of important subjects from foreign museums, such as of England, U.S.A., etc. They should keep illustrated popular books in their library; and place the library books so that visitors can read them in the library or take loans of them for certain periods by depositing their values. Some years ago, I visited 14 museums of India and the Mandalay museum, but found that there is nowhere any facility for reading museum-books.

H. Until the process of reorganisation of the museums and compilation of guide books and catalogues is completed, the curators and other museum authorities should refrain from writing and publishing research works, in imitation of big foreign museums, which enjoy the advantage of possessing competent staff for the purpose and sufficient funds for publishing such books.

7. The Indian Museum of Calcutta, as the biggest premier museum of India, should first set its house in order by transforming itself into a special Educational Museum as contemplated in my scheme, by curtailing unnecessary expenses in

the existing departments and adding to it such exhibits as are helpful in promoting general knowledge of the students and others regarding various important subjects, which have been hitherto left out. After it has taken its place as an exemplary central museum in Bengal, other provinces may follow suit.

(a) It should gradually part with about a half or one-fourth of its vast stock of geological specimens (the total of which is 300,000 kept in reserve); rock specimens (out of 21,000); vertebrate fossils (out of 27,000) to the geological or mining colleges and to the general museums according to their requirements. It can also make a gift of some extra stuffed or preserved animals, birds, fishes, insects, etc., and other exhibits which they can easily spare to other museums, and also to colleges and schools which have their own buildings and which actually want them for teaching purposes. Without such help and liberality, other museums cannot collect these specimens in a century, which Government has collected in more than 25 years.

(b) I have been watching for several years the number of readers who have attended the *Imperial Library* and the *Commercial Library* of Calcutta since they were founded; and noted that the number shows an increase from 4 or 5 at the beginning to 80 or 100 per day at present. The Indian Museum may take a note of this. At present the visitors have no easy access even to its own publications and other books of the library. If suitable facility be provided to the readers, their number will swell still further year after year.

(c) It should decorate its bare walls with attractive pictures and illustrated charts relating to zoology, aboriginal races of India, natural phenomena, wonderful railways, steamers, aeroplanes, buildings, electric machines, health and hygiene, etc., as hinted in this book in connection with different classes of exhibits.

(d) It should appoint 4 or 5 lecturers or teachers for imparting general knowledge of suitable subjects, such as,—(1) Physiology, health, sanitation, evils of drinking and smoking, social evils, properties of ordinary foods ; (2) Physical culture, recreation through plays, such as, singing and dancing, etc.; (3) Maternity and child welfare; (4) Scientific recreations; (5) Technical subjects.

(e) It can arrange for weekly, monthly or occasional lectures on the subjects mentioned in the above paragraph by some science teachers, physicians, physical culturists, lady doctors, heads of manufactories, chemists, etc., who are easily available in Calcutta.

Archaeology.—One of the greatest obstacles in the way of progress and reformation of Indian education by means of museums, is the attaching of undue importance to the articles of antiquity. Archaeology is a minor, and comparatively unimportant subject and its educative value so far as Indians are concerned is very small. My heart aches to see that some lovers of antiquity hold contrary views. Books written on the subject are so technical that they are beyond the grasp of average graduates, and the general students cannot derive any practical benefit from their study. The names of the exhibits and their significance

and the erudite narrations of ancient races and dynasties, their arts and architecture, their curious or strange coins, inscriptions, etc. are too difficult to understand or to form an idea thereof, unless new chairs are created in our universities, like those in the universities of England. This kind of knowledge is much more complex than that found in school text-books on history, elementary physics or mechanics. If any one entertains any doubt about my above statement, I would request him to read "A Guide to Taxila" and its Glossary written by Sir John Marshall, the former Director General of Archaeology in India, or any of the books mentioned in the "Short Bibliography" of the book and satisfy himself. It might take a quarter of a century to dispel the prejudicial over-estimation of the importance of archaeology made by some government officials and those who have a hobby for it. In "Educational Reformation," chapter VI, I have devoted 11 pages to show how for centuries similar prejudices have already done and are still doing immense harm to mankind. They always put obstacles in the way of reformation of education and they set at nought the reasoning faculty and conscience. It is, therefore, no wonder that they put obstacles in the path of museum-education also.

2. It is yet a mystery to me why a certain class of people have fascination for the study of archaeology in preference to that of wonderful productions of modern inventions and discoveries. When we see beautiful things, we feel pleasure; when we see useful articles, we buy and use them; when we see wonderful things of nature

and art, we are astonished. But the relics of old have seldom any beauty to attract our attention or wake up pleasurable memory; or any usefulness to mankind to generate a desire for imitation. As regards their cultural value, they are, to my mind, far inferior to the marble or metallic statues, exact representations of their originals, which are adorning the *maidan*, the Victoria Memorial, the town hall, the senate house, and other public buildings and parks of Calcutta and elsewhere in India. The images of elemental gods and incarnations, mythological or historical persons sculptured from unrefined imagination of untrained sculptors are destined to be defective. In comparison with modern palatial buildings, beautiful architectures, such as, skyscrapers of New York, gigantic bridges, Panama Canal; the ancient buildings of India a thousand or two years ago were in no way superior to the ordinary buildings of modern time. In point of aesthetic taste and artistic designs, the marble and metallic statues which adorn the drawing-rooms, court-yards, parapets, gardens of the rich; and the beautiful idols of stone or metal of Srikrishna and Rádhá, Rámchandra and Sítá, Buddha and Chaitanya, which are daily worshipped in Calcutta and other cities of Bengal; and thousands of earthen idols of Hindu gods and goddesses, such as, Shiva, Durgá, Jagat-dhátri, Saraswati, Annapurná, Lakshmi, Kártik, which are made 5 or 6 times every year in Calcutta, Dacca and other cities of Bengal, for being worshipped for only a day or two and then immersed in the water, are fairly beautiful productions. They arouse the spirit of devotion in

the minds of idolators. Most of the coins of old Greece or Rome are far superior to those of India. The beautiful glazed pictured vases of China, called *satsuma* art, are far superior to the glazed works of Mahenjodaro exhibited in the Indian Museum. The ceramics, ornamental articles of glass, enamelled works, nice ornaments ot silver and gold of the 20th century have surpassing beauty.

3. The Government employees in the Archaeological Department shall have to do their work and the lovers of the subject will, of their own accord, study it; but my point is that they need not interfere in the museum education. Now let me cite one hypothetical case to show what small importance antiquity possesses. If the books and articles of archaeology are locked up for 10 years, the progress of public education will not be hampered in any way; but if, on the other hand, the current education be stopped for 10 days, a great harm will be done to the onward progress of the students. Let the archaeologists think over the case calmly, and draw right inferences.

4. The articles of antiquity are occupying so much space in a museum, that they leave no room for things of far more educative value, unless additional accommodation is provided and more funds are found for them. Another difficulty is, that it is much more costly to maintain curators who have studied archaeology, than curators who possess only general knowledge. Four or five competent lecturers on health, arts, physics, mechanics, handicraft can be procured in the place of one such learned curator drawing a large salary.

Competent and experienced curators of Provincial Museums may well act as Superintendents or Inspectors of several museums in the country.

5. I would earnestly appeal to those who believe that museums can be made a powerful medium for diffusing useful general knowledge, to desist from thrusting into the already over-burdened brain and memory of the young people the knowledge of the arts, crafts and customs of the extinct races, but they should concentrate on imparting knowledge of modern arts, sciences and manufactures. I respectfully invite reasoned criticisms of my views as set out in this book, to enable me to write another book in the light of such criticisms and suggestions, if the Supreme Father is graciously pleased to spare me for some time with a healthy body and mind. It is a thousand pities that the antiquarian tendency of some archaeologists is trying to drag the mind of young visitors backward to the unearthed remains of ancient India from the progressive march of the 20th century ! It is also lamentable that more than half of the museums are stocking ancient relics! May this 50 per cent be reduced to 5 per cent is my ardent appeal to the patriotic authorities of museums, having advanced views. I, of course, exclude the local museums directly under the Archaeological Survey for obvious reasons.

6. Here, I should suggest that some of the ancient big images, stony walls, inscribed pillars or slabs of stone, and such other heavy things should be removed from the Indian Museum or other museums, and be distributed to the public parks, gardens, colleges, town halls, hospitals, etc. of Calcutta

and other cities of India together with inscribed descriptions of them.

7. This is a good method of relieving congestion in the museums and making room for more useful articles of educative value. Of course, museums should carefully preserve old coins, ornaments, jewels, seals, writings, inscriptions, and other small relics, under their custody. This is one of the simple, cheap and natural methods of spreading knowledge of ancient things. Another well-known method of disseminating knowledge of ancient things is the printing of the pictures of images, pillars, inscriptions, coins, walls, buildings, etc., with short descriptions and selling them to schools and colleges, as well as the public, as is done by the British Museum of London and other museums of England, U.S.A. and other countries. Also cheap small descriptive books should be written by experts in a popular language and published and sold. It is a pleasure to see such nice pictures and read excellent illustrated books published by foreign museums.

Introduction to my Publications

People of India, even the educated Indians, generally do not know how to cleanse the body properly; how to protect it from heat and cold, filth and microbes; what are the benefits of cleanliness; and what are the special hygienic rules for the **Care of the Eyes, Ear, Nose, Teeth and Mouth, Skin, Right Breathing, Diet and Digestion.** As there are very few cheap popular books on these subjects fit for the Indians, I felt the necessity of publishing such books for the education of the Indian people, especially the student community.

The Heads of Schools and Colleges are requested to peruse these books, and if they find them to be useful, they should induce the students to study them and improve their health. All educated persons of India should consider that it is their foremost duty to study popular books on Physiology, Health and Hygiene and follow the laws given therein. All books on other subjects are of secondary importance, because preservation of health should be the prime object of life.

Publisher

Some Extracts from the Reviews

"I think the paper (Care of the Teeth and Mouth) is very well written."—*R. Ahmad, D.D.S., Principal, Calcutta Dental College.*

"I recommend this little book about teeth to all who possess them."—*Calcutta Municipal Gazette.*

Care of the Nose and Care of the Ear.

"They are unique in character and I hope will be highly appreciated by the public."

—*Dr. S. Mitter, M.B.*

"These brochures contain in a nut-shell all that a layman should know about the ear and the nose." —*Scientific Indian.*

"These two excellent pamphlets will no doubt prove to be good addition to our health literature."

—*Indian Dental Journal.*

"They are very useful pamphlets."

—*Deputy Director of Public Health, U.P.*

"Care of the Teeth is a wonderful little book." —*S.N. Banerjee, Bar-at-Law.*

"Your little treatises are indeed very useful and should be read by the laymen widely."
—*Mahamahopadhyaya Kabiraj Gananath Sen, M.A., L.M.S.*

"We recommend this booklet (Right Breathing) to every reader for perusal."

—*Health and Happiness.*

"**Personal Hygiene** is a marvellous production." —*S. N. Banerjee, Bar-at-Law.*

"Not being technical, the book ought to be welcomed by those who contract diseases out of ignorance of the science of Hygiene." —*Leader.*

Diet of the Indians.—The youngsters should read, re-read and carefully ponder over the valuable suggestions."

—*Bansari Lal Sarkar, Advocate, High Court.*

"Your books are not only very readable, but useful. They should be introduced into every institution in Bengal, nay in India."

—*Capt. J. N. Banerjee, Bar-at-Law.*

"Dr. Tagore has read the books with much interest and pleasure. Dr. Tagore considers your books to be of great value for the spread of correct ideas on health and hygiene and hopes that they will receive the wide publicity which they certainly deserve."

—*Secretary to Dr. Rabindra Nath Tagore.*

"Diet of the Indians is an excellent book and both teachers and boys will find it profitable if they peruse it."—*Inspector of Schools, Patna Division.*

As it will take about 50 pages to publish all the Reviews, I mention only names of the Journals which have favourably reviewed most of the books ;– Longevity, Medical Practitioner, Burmah Medical Times, Indian Review, Antiseptic, Saraswati, Bombay Chronicle, Medical Comrade, Industry, Education, Modern Review, Federated India, Medical Digest, Venkateswar Samachar, etc.

Directors of Public Instruction of Madras, N.-W.F.P., Punjab, Assam and C.P. have approved most of the books.